THE

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THE SELF-PROPELLED TRAFFIC ASSOCIATION.

THE Self-Propelled Carriage Association, which met on October 26th at Liverpool, to hear an inaugural address by Sir David Salomons, is to be congratulated on their President and upon his address, which was a very honest statement of the whole case of motor vehicles as it stands to-day. Sir David, as everyone knows, is honest in his convictions, and has done much for motor vehicles. His experience has convinced him that our good friend and servant, steam, is alone to be depended upon for motor purposes, though he grants there is a certain field for other motors. His opinion is entitled to respect, and we are not surprised to find he is somewhat influenced by the Serpollet steam motor in favour of the steam actuated vehicle. To begin with, and here we cordially agree with him, no patent, in his opinion, which deals with self-propelled traffic is worth the paper it is written upon. We say we agree with him, with the limitation that the patents are for motors and not for supplementary details. He does not in this refer to their validity, but to their mechanical value. It is more a question of design and progress along determined lines rather than in patent rights, that motor vehicles must in the future become valuable properties, and we do not look to any great progress at the hands of promoters. We look to the manufacturer for the steady improvement and perfecting of motor vehicles. There are now no main patents on gas or oil engines; all have now expired which had any value. Sir David considers that many of the steam road carriages of 60 or 70 years ago would be considered very perfect to-day with but slight alterations, and he thinks in a few years at least nine-tenths of the road carriages will be steam propelled. As regards the last new Act for motor carriages, it is to be noted that Sir David considers it a good one.

Referring to the recent 1,000 miles race in France, he draws a funny picture of the manner in which the French send a vehicle to a contest without any preliminary test, and indeed he states that several carriages were only completed just in time to start.

The much spoken of Daimler motor has three main parts, (*a*) a double cylinder Otto engine, (*b*) a cam gear to work the valves, (*c*) a Corliss trip gear for governing. This last is the weak point in the Daimler engine not being suitable for a high rotative speed.

The Peugeot motor is an improvement upon the Daimler, having been deprived of many of the springs, and being generally more accessible.

The Levassor motor differs but little from the Peugeot. The Delahaye carriage ran well, and our own experience of this carriage is favourable. In motor-driven tricycles the Bollée has the fault of a single driving wheel, with a liability not to be always in contact with the road, and therefore dangerous. It is observed that all the drivers of the vehicles

were men of courage—a mild way of expressing the speeds attained downhill in order to secure the "average" speed on the whole journey, the uphill speed being slow. This slow uphill speed is at the bottom of Sir David's lack of appreciation of the petroleum motor. The chief interest of the race, indeed, centres in the fact that whereas motors have hitherto been of 3 to 4 horse-power, they are now of 6 horse-power. This confirms the President's previously expressed opinion, and, indeed, the general opinion of engineers, that the horse exercises several "horse-power" when mounting hills and making starts from rest, at which time the horse, though not in rapid motion, is expending energy internally in a manner clear enough perhaps to most people, though, as we recently learned, by no means understood in a certain editorial sanctum. The vexed question of the great standing vibration of benzine-driven carriages is referred to. This it very marked in single cylinder motors, and we fear is not likely to be eliminated altogether, unless by the use of two pistons in one cylinder, with a common explosion chamber between them.

We note the lecturer's opinion on the steering qualities of motor vehicles:—"It is far easier to guide such vehicles than any horse." "I was able to prove this to the complete satisfaction of Major Tulloch, C.B., who visited Paris officially at the instance of the Local Goverment Board." This is a strong statement to make, yet we believe it to be substantially correct. This is contrary to opinions we have previously expressed, and we would qualify our belief to-day with the claim that the guiding wheels must be on the modern system entirely independent of each other in their mounting, and not mounted on a "lock" frame. With the modern mounting, we have been surprised at the nicety of guiding with sober drivers.

As regards benzine motors, there are numerous difficulties in practice, such as the necessary periodical grinding of the valves, the water jackets, the horrible smell of the exhaust—a charge made rather against the heavy oil motors than against those using benzine—the general complication of parts, and so on, rendering it necessary that the driver should be, at least, somewhat of a mechanic. All this, too, is without the question of storage of inflammable liquids, their carriage by rail, and so on, a difficulty which is to be eventually overcome by some means of solidification, and restoring them easily to liquid form as required.

Thus Sir David, who follows up his list of disadvantages by an equally formidable list of advantages, including the ability to travel long distances at a fair average speed, and the ability of the owner to drive his carriage from within a glass canopy. A journey of 24 hours ought easily to be made without taking in supplies. On the general question of design, we are glad to see that Sir David is not in favour of so sedulously concealing the machinery, as is now the habit. Practically, all carriage makers at present aim at making a motor car resemble a horse car, minus the horse. Like the Chinaman who exclaimed on his first sight of the cable car, "No pushee, no pullee, go like hellee all samee," the idea has been to box the engine out of sight, and leave no sign of the motive agent. We confess to a feeling that the standard motor car is an uncanny beast, a sort of devil actuated entity, devoid of human touch. We want to see the wheels go round, and we want to see why they do so. The hideous black box, too large to be tucked out of sight, too small to conveniently contain the machinery, need not be so hideous and black. Its sides might be of glass, and its position is, perhaps, not the best possible.

The Serpollet engine, on which Sir David's faith is pinned, went ahead of all other vehicles, whether horse or motor drawn, on a trip from Paris to Versailles. It was heated by a heavy oil petroleum burner, and only needed to take in water every three hours. It held two people, and cost only £120. It is ready to start with five minutes' preparation in warming up the burner to lighting point with methylated spirit. It is simple, understood by any village smith, and the boiler is small, non-explosive and self-cleansing. The disadvantage of having to clean the boiler with hydrochloric acid on which we commented some time ago is specially referred to as an error on our part. No cleaning is required, and we ought not to have made the statement on the strength, we believe, of an official statement by the Serpollet people themselves, or of a published account which we understood to be authorised. It seems that the calcareous salts are formed in very fine powder, are carried forward by the rush of steam in the small tubes, and serve to lubricate the pistons. Perhaps it is so, but fine calcareous powder, which at best cannot be superior to levigated chalk, is not what we would personally choose as a cylinder oil. All the same, the Serpollet carriage is a proved success. It recently covered 240 kilometres in 10 hours at an average speed of nearly 16 miles an hour, including stoppages—no mean achievement. It is in trade vehicles that the immediate future of this mode of propulsion will be made, and obviously it is just in these vehicles that steam will find its best field. "Sportin' gents" will not drop the horse; poorer men and small tradesmen will not buy motor vehicles until they can be assured of their completely satisfactory action, and the explosive oil engine will not be a favourite unless it ceases to vibrate. But what of electricity? Of this agent Sir David has not ten lines to say. Electrical carriages are impracticable because of the weight of accumulators and the necessity of charging stations, while the comparatively light accumulator rapidly charged and discharged must be so frequently renewed, that few would face the expense. He simply grants that electrically driven carriages may have a limited use. This is not encouraging, yet it is, up to date, a fair statement of the actual facts. At present, the use of electrical carriages is limited to either a run of a few miles between two previously arranged charging stations, or to a loop journey ending at the initial point. The difficulty lies in the want of charging stations all over a large area of country. Until such exist there can be no large use of electric carriages. Until there are large numbers of electrical carriages to use such stations, there will be no stations. This demand for simultaneity bars the rapid growth of any system of accumulator worked carriages, and any growth will be in the slow connection of one charging centre after another, as each town develops its own locally worked carriages. The difficulties are great. The want of a recognised standard form of cell, the exchange of cells at charging stations, or the alternative of delay while recharging, all loom up large in the future. Too much is known of secondary batteries to allow any extravagant ideas to obtain. All the same, an approximation to the theoretical possible

would completely change the status of the accumulator, and it is in this direction that the success of the clean, well-balanced, and most convenient electrical car must lie. Its advantages in many respects are so enormous, that a comparatively small mileage per charge would be forgiven. If we could even halve the present weight of an accumulator, the conditions would be very much more hopeful. Nor is such an improvement outside the bounds of possibility, but its accomplishment must, of course, be accompanied by at least an equal durability with present cells. We consider Sir David's address to be a valuable contribution to the literature of motor vehicles.

Storage Battery Locomotives on the New York Elevated Railway.

Apropos of Sir David Salomon's address at Liverpool, to which we refer in another column, we may mention the use of storage batteries used on the New York elevated railways. The *Electrical Engineer*, of New York, describes a storage battery locomotive at work on the Thirty-fourth Street branch of the 3rd Avenue line. Our contemporary suggests the use of a system of feeders in conjunction with accumulators in order to secure a steady load at the power station. A locomotive so fitted will absorb more power than it uses when at one end of the line, and will give out more than it absorbs when at the other end furthest removed from the power station. The combined system enables the conductor to be more rapidly tapered towards the distant point. Every train will be able, when starting from rest, to absorb energy from trains ahead or astern of it that may be coming to a stop. A steadying effect would, of course, be secured by accumulators at the power house, but this would not reduce the amount of copper in the leads. The gist of the idea is that accumulators must be carried about in order that the leads may be reduced. Just how much real economy will result from this will be a matter of calculation in each case. The Storage Battery Company, who hope to convince the elevated railroad of the economy of their system, point out that objectionable places along the line, crossings, car houses, &c., may be omitted in respect of having the third rail laid past them. Across such gaps the trains will run by their accumulators. It is calculated that the acceleration of a train will be more rapid than with steam, and that the headway may be correspondingly reduced and the number of trains increased. We hope to see something done with the accumulator in order to demonstrate its possibilities. We believe that on tramway service the combined system has already shown good results in enabling trolley-line cars to run into cities where the trolley line itself is not everywhere admissible. The cells level up the load curve, bridge over the line gaps, and generally secure steadiness as well as permitting a smaller power plant.

Technical Education.

Mr. Sidney H. Wells, principal of the Battersea Polytechnic Institute, writes a letter to our contemporary, *Engineering*, in reply to the recent leader on which we commented recently. Mr. Wells sets off *Engineering* against itself, and shows the recent leader not to be quite consistent with *Engineering* of July 17th last. He denies that the teaching of science to the rank and file has had any bad effect or caused them to think they can all be generals. It has not spoiled them for mechanics, and he quotes Mr. Mather M.P., as a witness in favour of employing boys who have spent two years in a systematic study. Mr. Wells contends that any hundred lads so prepared would be found superior, at 21 years of age, to any hundred who at 14 had passed direct to the workshop. This test, if confirmed, would apparently make for the technical education, but it would not be a fair test. Without wishing to decry the value of the better education, is it not a fact that the hundred boys trained would possess one at least of the following advantages. 1. A superior force of character urging them on the path of study. 2. Parents better able to afford such study. 3. A better nourished frame, and therefore a physical superiority. In an ordinary artisan's home the chilling influence of wealth cannot be held to exist. The boy of the artisan class, whose parents are the best off in wordly goods, stands the best chance because his worldly status has certainly not gone above the point where prosperity dulls ambition or produces a surfeit of comfort. Thus it is that the arguments of men like Mr. Wells savour somewhat of circular reasoning; of a confusion of cause and effect. The man who is best educated is not found to be better advanced solely because of the education. We might take the converse proposition and ask why is this man better advanced than his fellows, and the reply would be because of the position of his parents or the possession of a robust constitution. But have not a very large number of English working men had the benefits of more or less technical education for over 20 years. The old Science and Art classes taught a good deal in their time, though since overshadowed by the technical schools, and as we said last week in agreement with Mr. Preece, the immediate want of to-day is either a more scientifically educated employer, or one better able to appreciate the possession of knowledge in his subordinates. By all means let us have education of the masses, but that of the classes is of greater moment. The ruin of the country, which is certainly an accomplished fact if we are to accept all true that is stated of the foreigner during the past 10 years, receives a commentary of some interest on the same page of *Engineering* as Mr. Wells's letter. It only occupies six lines, but it tells how the rateable value of Blackpool—the holiday resort of Lancashire—has more than trebled since 1876, while the population has doubled since 1886. Do such things happen in ruined countries? Why also, on the same page, do we find the N. E. Rly. so anxious to spend half a million on new docks at Hull? Possibly we have gone a bit slowly in some respects, but we are not yet ruined, and we all seem to be alive to the necessity of stirring ourselves, unless it be the over rich employers who have grown fat and idle.

"Honour to Whom Honour is Due."

The list of foreign orders that have been conferred upon Prof. D. E. Hughes has been added to by the King of Servia, who has presented the Grand Officer's Star and Collar of the Royal Order of Takovo. We doubt whether more than one Englishman living possesses more foreign decorations than Prof. David E. Hughes; certainly no electrical man ever met with such distinguished recognition outside his own country. Eight European Governments have done him honour, yet the only instance in which the British Government officially recognised Prof. Hughes was when it appointed him a Commissioner to the Paris Exhibition. No doubt Prof. Hughes's invention, the type printing telegraph, has been more appreciated in foreign telegraphic systems than in this country, but, apart from that remarkable instrument, Prof. Hughes has done great services to electrical science. It would not be easy to overrate the importance of the microphone, yet this was freely given to the world. In other directions Prof. Hughes has laboured and wrought with success, and we feel sure that there is not a single electrician living who would not rejoice if our own Government were to bestow some honour upon him.

COMMUTATOR BRUSHES FOR DYNAMO-ELECTRIC MACHINES, THEIR SELECTION, THEIR PROPER CONTACT AREA AND THEIR BEST TENSION.*

By ALFRED E. WIENER, E.E., M.E., M.A.I.E.E.

In designing dynamo-electric machinery, care should not only be exercised in the direction of obtaining the best possible dimensions, windings, and electrical and magnetical efficiencies, but the desideratum should also be to produce machines of best *performance* when subjected to working conditions. But the performance of a dynamo when running depends chiefly upon the design of the current collecting device; the commutator brush in consequence, is one of the most important parts of a dynamo-electric machine, and its design, in order to achieve best results, should be worked out with as much attention as that of the field frame or of the armature.

The proper design of the commutator brush consists (1) in the selection of the material and form best suitable for the particular purpose; (2) in an appropriate dimensioning of the brush contact area, in accordance with the current output of the machine in question; and (3) in the determination of the most favourable brush-tension.

Fig. 1.—Sloping Copper Wire- (or Leaf-) Brush.

Fig. 2.—Tangential Copper Plate Brush.

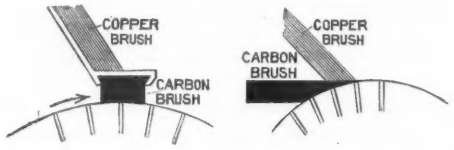
1. *Material and Kinds of Brushes.*—For low potential machines having a large current output, such as incandescent lighting generators, electroplating dynamos and machines for electro-metallurgical purposes, it is the practice to employ thick *copper* brushes, made up either of copper wires or copper strips, or copper wire gauze, in order to secure a large number of contact points, and to set them so as to make an angle of about 45° with the commutator surface, as shown in fig. 1. In small dynamos often springy copper plates are used which are placed tangentially to the commutator periphery, as illustrated in fig, 2. For high potential machines, especially for railway generators and motors, *carbon* brushes are used in order to aid in the sparkless collection of the current at varying load. As each commutator segment enters under the brush, the area of contact is, at first, very small, and owing to the high specific resistance of carbon, a considerable resistance is offered to the passage of the current from the branch of the armature of which that segment at the time is the terminal, into the external circuit. This gives rise to a considerable local fall of potential, which diverts a comparatively large portion of the armature current

Figs. 3 and 4.—Tangential and Radial Carbon Brush.

through the neighbouring coil into which it flows against the existing current, causing the latter to reverse quickly in opposition to the E.M.F. of self-induction, thereby preparing the short-circuited coil to join the successive armature circuit of opposite polarity without sparking. The resistance of the carbon brushes cannot be depended upon for the complete commutation of the entire current, but in most generators, especially those with toothed and perforated armatures, fully half the armature current may be thus commutated. In railway generators it is usual to adjust the brushes so that at no load they are in the neighbourhood of the forward pole-tips where the pole-fringe E.M.Fs. generated are sufficient to reverse one-half of the normal current, the remaining half being then taken care of by the carbon brushes.

Carbon brushes are either set tangentially (fig. 3), or radially (fig. 4) with respect to the commutator circumference, the latter arrangement having the advantage of admitting of reversal of the rotation without changing the brushes.

To use carbon brushes exclusively on machines of low voltage would be very bad practice, because carbon has so much higher resistance than copper, that the drop of potential would be excessive, and too great a percentage of the power of the machine would be used up for commutation. If, therefore, the resistance of an ordinary copper brush is not high enough for sparkless collection, a copper gauze brush must be employed which has a much higher resistance than a copper leaf brush, and while there are some mechanical advantages in using it, such as cooling effects and smoother wear of the commutator, yet the principal reason it stops sparking is that it has a higher resistance. In case the resistance is still too low, the next step is the application of a *brass* gauze brush having about twice the resistance of copper gauze. If that is not enough yet, some form of carbon brush which has its resistance reduced, must be



Figs. 5 and 6.—Combination Copper-Carbon Brushes.

resorted to. Carbon itself cannot have its resistivity changed, but by mixing copper filings with the carbon powder, or by moulding layers of gauze in it, the conductivity of the brush can be increased. Instead of artificially decreasing the resistance of carbon, *combination brushes* consisting either in copper brushes provided with carbon tips (fig. 5), or in carbon brushes sliding upon the commutator and having, in turn, copper brushes resting against themselves (fig. 6), are sometimes employed, and in case of very heavy currents the addition to each set of copper brushes, of a combination brush set somewhat ahead of the copper brushes, as shown in fig. 7, has been found to greatly improve the sparkless running of the machines. With the latter arrangement the tension on the combination brushes should exceed that on the copper brushes sufficiently to enable them to take their full share of the current as nearly as possible.

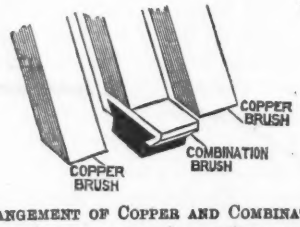


Fig. 7.—Arrangement of Copper and Combination Brushes for Collection of Large Currents.

2. *Area of Brush Contact.*—The circumferential thickness of the brushes—according to the current capacity of the machine, to the grouping of the armature coils, to the material and kind of the brush, and to the dimensions of the commutator—varies between less than the width of one to that of three, and even more, commutator segments. In case the brush covers not more than the width of one bar, as in fig. 8, only one armature coil is short-circuited at any time, while in the case of brushes thicker than one bar plus two side insulations (fig. 9), two or even more coils, at times, are simultaneously short-circuited under each set of brushes.

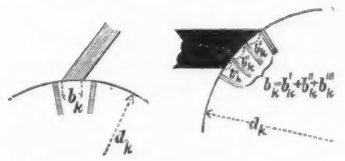
The breadth of the brush contact surface in the former case (fig. 8) is equal to the thickness of the bevelled end of the brush measured along the commutator circumference; in the latter case (fig. 9) it is the breadth of the brush bevel diminished by the sum of the thicknesses of the commutator insulations covered by the brush, and can be generally expressed by the formula:

$$b = n \times \left(\frac{d \times \pi}{N} - i\right) \qquad (1)$$

where b = circumferential breadth of brush contact, in inches;
n = number of commutator bars covered by the thickness of one brush;
d = diameter of commutator, in inches;
$d \times \pi$ or $3{\cdot}14 \times d$ = circumference of commutator in inches;
N = number of commutator divisions;
i = thickness of commutator side insulation, in inches;
i = ·020″ to ·030″ for dynamos up to 300 volts E.M.F.,
= ·030″ to ·040″ for dynamos from 400 to 750 volts,
= ·040″ to ·060″ for dynamos from 800 to 3,000 volts.

If the brush covers less than one bar, as in fig. 8, n is a fraction; if the width of the brush is from one bar to one bar plus two side insulations, $n = 1$; when between two bars plus one insulation, and two bars plus three insulations $n = 2$, &c.; and if the brush covers from one bar plus two insulations to two bars plus one insulation, or from two bars plus three insulations to three bars plus two insulations, &c., the value of n is a mixed number consisting in an integer and a fraction.

Having decided upon n, and having calculated b from (1), the width of the contact area, and subsequently the width of the brushes, can be found for a given current output of the dynamo by providing contact area in proportion to the current intensity. In order to keep the brushes at a moderate temperature, and the "loss of commutation" within practical limits, the current density of the brush contact should not



Figs. 8 and 9.—Circumferential Breadth of Brush Contact.

exceed 150 to 175 amperes per square inch in case of copper brushes (wire, leaf, plate and gauze), 100 to 125 amperes for brass gauze brushes, and 30 to 40 amperes in case of carbon brushes. Or, specific contact area should be provided at the rate of from 5,700 to 6,700 sq. mils per ampere for copper brushes, from 8,000 to 10,000 sq. mils per ampere for brass gauze brushes, and from 25,000 to 33,300 sq. mils per ampere for carbon brushes.

Taking the lower of the above limits for the current densities, the effective length of the brush contact can be expressed by

$$l = \frac{C}{150 \times p \times b}, \qquad (2)$$

for *copper* brushes, by

$$l = \frac{C}{100 \times p \times b}, \qquad (3)$$

for *brass* brushes, and by

$$l = \frac{C}{30 \times p \times b}, \qquad (4)$$

for *carbon* brushes, the symbols employed being:
l = effective length of brush contact surface, in inches;
= $s \times w$ (s = number of brushes per set, w = width of brush);
C = total current output of dynamo, in amperes;
p = number of pairs of brush sets (usually either $p = 1$, or is = to the number of divisions of the armature current).

For the purpose of securing a good contact, the length, l, should be subdivided into a set of s individual brushes of a width, w, each, not exceeding 1½ to 2 inches. In small machines where one such brush would suffice, it is good practice to employ two narrow brushes, even down as low as ⅜ inch each, in order to facilitate their adjusting or exchanging while the machine is running.

As an illustration of the use of the above formulæ. The brush contact surface for a 500 volt 150 ampere generator is to be computed, the commutator of which has 90 divisions and a diameter of 10 inches, and which has two sets of tangential carbon brushes, each covering the width of two commutator bars. In this case $n = 2$, $d = 10$, N = 90, and the thickness of the commutator insulation, which for 500 volts should be taken between ·030 and ·040, is assumed i = ·036. According to formula (1), therefore, the breadth of the contact area is

$$b = 2 \times \left[\frac{10 \times 3{\cdot}14}{90} - {\cdot}036\right] = {\cdot}626 \text{ in.} = \tfrac{5}{8} \text{ in.}$$

As carbon brushes are used, formula (4) is to be employed for the length of the brush contact; for C = 150, $p = 1$ and $b = \frac{5}{8}$, we have

$$l = \frac{150}{30 \times 1 \times \frac{5}{8}} = 8 \text{ ins.}$$

The machine in question thus requires a contact area of ⅝ inch × 8 inches for each set of brushes, or, there should be four carbon brushes of ⅝ inch × 2 inches cross section in each of the two brush sets.

(To be continued.)

THE RÖNTGEN RAYS.

Since the true explanation of the nature of the Röntgen rays appears at the present date to be as far off as ever, the true policy of the physicist just now is to accumulate experimental facts, in the hope that the *experimentum crucis* which will point the way to the correct theory may soon be discovered. Some recent investigations by Italian physicists on this subject appear to be of the highest interest.

Sandrucci (*Nuovo Cimento*, Ser. iv., Vol. iii., p. 353) has carried out a series of experiments to settle the disputed point as to whether the Röntgen rays act directly on the photographic film or indirectly, by producing phosphorescence in the glass in contact with the film. Sandrucci divided into two exactly equal parts a Lumière dry plate, 13 × 18, from which the sensitive film had been completely removed. The first half of this plate was placed directly on the film of another Lumière plate, 13 × 18, so as to cover exactly one-half of it; the whole was enclosed in a suitable opaque envelope of silk, very homogeneous, and perfectly opaque to ordinary light. The other half of the divided plate was then placed outside the envelope, so as to cover exactly that half of the sensitive plate not covered by the glass inside. With such an arrangement the Röntgen rays, directed upon the envelope, have, on one-half, to pass through first the envelope, and then a glass plate, to reach the sensitive film; while, on the other half, they have to pass first through a glass plate, and then through the envelope. The obstacles to be traversed by the rays are the same, but the order, in the two cases, is opposite. The effect of the fluorescence of the glass on the sensitive film ought to be very different on the two halves; the fluorescent light from the external superimposed glass plate ought to have no effect on the sensitive film, since it would be effectually excluded by the opaque envelope. On the other hand the light from the internal superimposed plate, which is immediately in contact with the sensitive film, ought to exercise its full photographic effect. One of two results may be expected from this experiment. 1. Uniform photographic action over the whole sensitive film; hence no action or a negligible action of the fluorescence of the glass. 2. Greater blackening of that half of the plate covered internally by the glass; hence effective action of the fluorescence, if not exclusive, at least concomitant with, and assisting that of the Röntgen rays.

The Crookes tube used in the experiment was pear-shaped, with a concave electrode, and was excited by a bobbin, 32 centimetres in length, worked with a primary current of 8 amperes. The tube was placed at a distance of 15 cm. from the photographic plate, with its axis vertical. The exposure

lasted an hour, because, owing to the coil being new, it was not considered safe to use a longer spark than 5 centimetres. On development, a fine line, much darker than the rest of the plate, was found running across the centre of the plate, indicating the small gap at the junction of the two superimposed plates. On both sides of this line the plate was slightly darkened, and sensibly uniform. In the estimation of a number of persons who examined the plate, that half was slightly darker which was covered by the external glass plate.

This experiment appears to prove without any doubt that the Röntgen rays act directly on the sensitive film, and not through the intervention of the fluorescence which is produced in the glass which supports it. The fact that the action of the rays was strongest behind the plate furthest from the sensitive film, appears to be connected with the well ascertained fact that the rays rapidly bend inward after passing an obstacle.

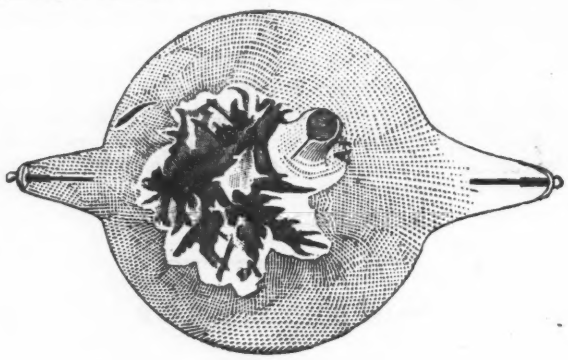


Fig. 1.

Villari (*Nuovo Cimento*, l, c., p. 359), has made some interesting experiments to determine the distribution of electricity on the surface of Crookes and Geissler tubes, by sifting over them a mixture of powdered sulphur and red lead. As is well known, the red lead, under these circumstances, will adhere to a negatively charged surface, and the sulphur to a positively charged surface. When this electroscopic powder was sifted on a spherical Crookes tube in action, a red spot of red lead was formed on the glass wall of the bulb where it was struck by the cathode beam, showing that at this place the glass wall had acquired a negative charge. The best result is obtained by sifting on the powder just after the cathode discharge has stopped.

The figure shown in the illustration, fig. 1, was obtained in this way. The central shaded part corresponds to the spot of red lead. Round about this, and also a little in the

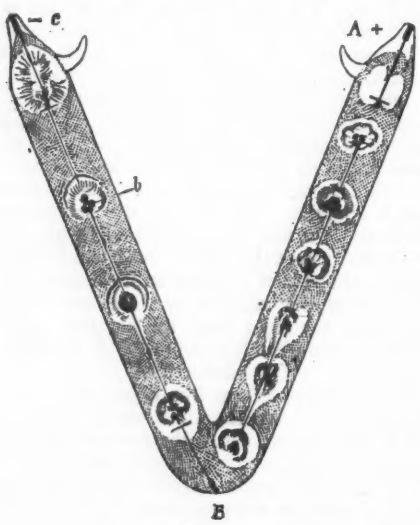


Fig. 2.

centre, is a neutral zone, indicated by the absence of shading, which is free from both red lead and sulphur. Over the rest of the bulb a thin layer of sulphur is deposited, indicating the presence of a uniformly distributed positive charge.

If the sifting on of the powder is continued while the tube is in action, the red spot is continually changing its form, owing to the fact that the cathode light on the glass wall is continually moving about. There is deposited on the nipple of the cathode a little red lead, which sometimes spreads out in beautiful long ramifications. A neutral zone, characterised by bare glass, separates this deposit of red lead from the sulphur.

In the case of a V-tube (fig. 2) with three electrodes, A, B, and *c*, when *c* is the cathode and A the anode, the cathode light strikes on the disc, B, at the angle, and the anode radiation diffuses itself over the whole tube. When the electroscopic powder is sifted on to this tube, it covers itself entirely with a layer of sulphur, except at the angle and round about the cathode, where a few cathode rays are given off; at these two points there is a slight deposit of red lead. If immediately after the discharge, in this tube, has been stopped, a wire connected to earth is rubbed along it, the positive anodic charge of the glass attracts negative charges on to those points over which the wire passes. On afterwards sifting on the powder the track of the wire will be indicated by a red line. If the wire is drawn along the tube while it is in action, more complicated figures appear when the powder is afterwards sifted upon it. These (fig. 2) are characterised by a central red line and by spots having yellow and red zones intermixed with bare neutral zones.

When a pear-shaped Crookes tube with a hinged cross was used, the distribution of the surface charges differed with the degree of exhaustion. In the first period (when the tube had a moderate resistance) the whole of the tube, except the apex, was covered with a layer of sulphur or red lead, according to the direction in which the current passed; the apex having, of course, always the opposite colour from the rest of the tube. In the second period (when the resistance of the tube was high) the tube was never completely covered with red lead, but a cathodic pattern, similar to that in fig. 1, was formed on the side of the tube opposite the folded down cross when this was acting as the cathode.

Geissler tubes, which have a comparatively high conductivity, show no surface charge when tested by the electroscopic powder.

These experiments of Villari's appear to show that there can be no such thing as a return current over the glass from the anti-cathode to the anode, which puts those physicists, who believe in the charged atom theory of the cathode rays, on the horns of a dilemma.

VEERING DRUMS FOR LIGHTSHIPS.

Capt. H. Benest, of Silvertown, has recently devised an ingenious form of veering drum for use in connection with the all-important problem of telegraphic communication with light-ships.

The particular object in view, is to provide light-ships, which are fitted with an electric cable, with means for automatically securing the normal condition of twist in the electrical cable while the vessel swings round under the action of the shifting tide or wind.

Fig. 1 shows in side elevation the arrangement of apparatus employed for taking in and letting out the electric cable by means of an automatic swivelling drum which is capable of being traversed towards and beyond the stem of the light-ship.

A is the drum, which turns in bearings in a bow-shaped frame, B, pendant from a vertical tubular pivot, C, which is flared out at its opposite ends, to facilitate the passage through it of the electric cable, as it passes up from the bottom of the sea to the drum, or runs out in an opposite direction. This tubular pivot is furnished with a collar, *c*, which bears upon anti-friction balls, *d*, running in an annular groove formed in a travelling cross bar, D.

E is one of a pair of rails carried by a pair of light parallel frames, F, which stand up from a fixed platform, G, raised to a level with the bulwarks of the light-ship.

The travelling cross bar, D, is furnished with a pair of bracket arms, d^1, which form bearings for a shaft, H, one end of which is squared to receive a winch handle. Keyed to this shaft, H, is a pair of pinions, *h*, which gear into a pair of racks (not shown in the drawings) affixed to the parallel frames, F.

I is the electric cable, drawn up from the sea, and passed

through the ordinary swivel, K, of the mooring cables to the drum, A, around which the surplus portion of the cable is wound, prior to its connecting with the swivel contact plate, L, in electric connection with the telegraph or telephone instrument.

The figure shows the drum in its usual working position, but if it is found necessary to move it inwards, out of reach

The action of the apparatus is as follows :—

Supposing the light-ship to have been swung round by change of tide or by a chopping wind, a tendency will be given to the cable to twist, and not only displace the electric wires from their central position, but become entangled with the mooring chains. This twist, before any danger has occurred, will work itself along upwards to the drum, and

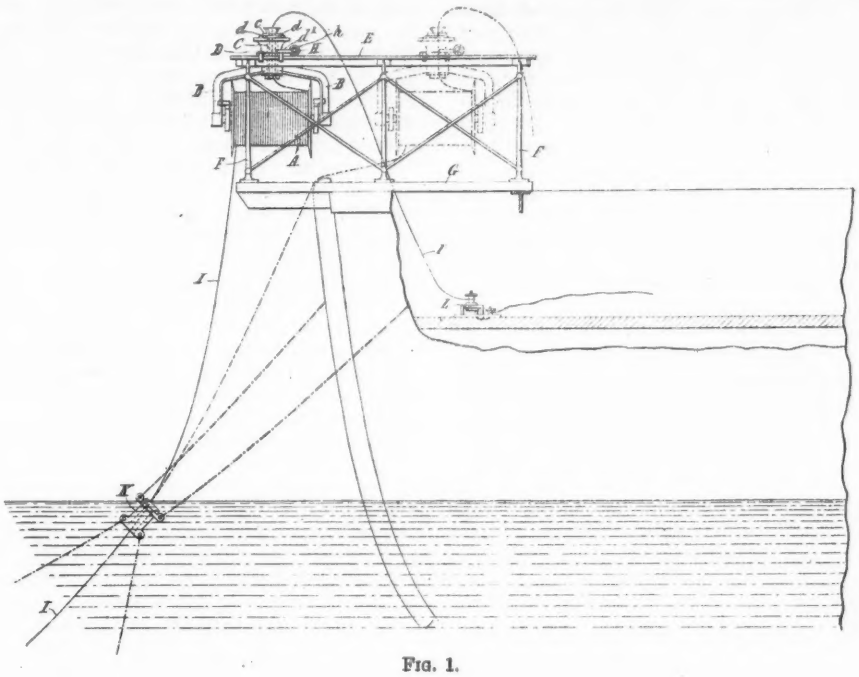


Fig. 1.

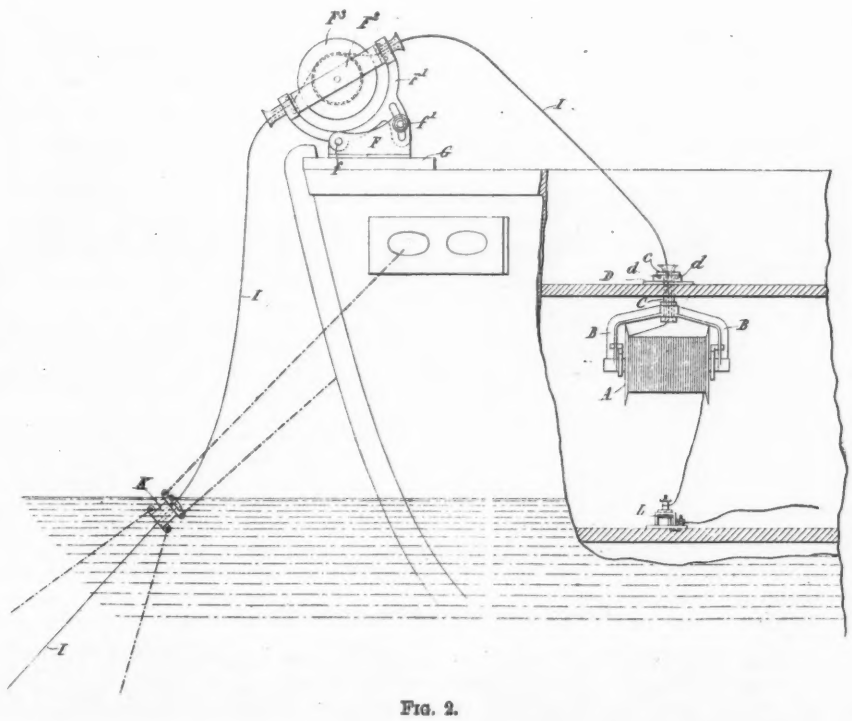


Fig. 2.

of the wash of the sea, the winch handle applied to the shaft, H, will cause the pinions, *h*, to rotate, and draw back the drum into the dotted position.

The drum shaft is fitted with the usual means for imparting axial motion thereto, for winding or unwinding the cable, and for locking the drum fast when a sufficient length of cable is wound up or paid out.

thereby convey an impulse sufficiently strong to turn the suspended drum on its vertical axis, and restore the normal condition of twist in the cable. The same result will be effected when the drum is moved inboard to the dotted position, to shelter it from the wash of the sea, when the vessel is pitching heavily. In this case, the electric cable, instead of hanging free of the vessel, would rest lightly on the score

of the bow chock, but it will be free to impart the requisite swivelling motion to the pendant drum, and thus automatically neutralise the twist which it has been caused to take.

To avoid the objections that may be raised to the exposure of the swivelling pendant drum to the weather, Capt. Benest proposes, instead of travelling the drum on a railway, as described with reference to fig. 1, to place it below the deck of the vessel, and to arrange a swivelling guide pulley (which will permanently project over the stem of the vessel), to lead the electric cable from the sea to the sheltered drum.

This arrangement is shown in side elevation by fig. 2, where A is the swivelling drum carried by the bow-shaped frame, B, between decks. This frame depends from the vertical tubular pivot, C, which is supported, as before described, on antifriction balls, *d*, in this case running in an annular groove in a plate, D, affixed to the upper deck.

In this arrangement, G is a raised platform carrying a plate, F, formed with a pair of lugs to receive a horizontal fulcrum pin, *f*, which serves to support a vertical rocking frame, F^1. This frame carries a swivelling frame, F^2, in which is mounted a guide pulley, F^3.

The trunnions of the frame, F^2, are tubular, and flared, to permit of the electric cable passing inwards to the guide pulley, taking a lap around that pulley, and then passing out and rearwards to the vertical tubular pivot, C, from which the drum, A, is suspended between decks. The axle of the guide pulley, F^3, is at right angles with the axis of the swivelling frame, F^2, and it is free therefore to yield to any torsion that may be put upon the electric cable.

To allow of the adjustment of the axis of the frame, F^2, to suit the inclination of the electric cable, the frame, F^1, is made adjustable in its bearings, and it is fixed at any desired angle by a clamping bolt, f^1, which passes through lugs on the plate, F, and through a segment slot (struck from the axis of the fulcrum pin, *f*) formed on the frame, F^1.

The electric cable, as it leaves the guide pulley, F^3, passes down the hollow pivot, C, to the drum, A, and after forming a suitable number of coils thereon, is led to the swivel contact plate, L, as before. The action of the apparatus, it will be understood, so far as the twist of the cable is concerned, is identical with that first described and shown in fig. 1, the pendent drum being sensitive to any torsion put upon the electric cable.

THETFORD ELECTRIC LIGHTING STATION.

The public supply of electricity in the ancient borough of Thetford, a charming Norfolk town of some 4,250 inhabitants, was begun in 1888 by Messrs. Paris & Scott, of Norwich, who transferred their interest to the local company in 1890.

There is no street lighting, but the Great Eastern Railway Station, the Post Office, Parish Church, Anchor Hotel, and the majority of shops and private residences are supplied. Electricity is also supplied to a large installation of arc lamps in the engineering works of C. Burrell & Sons, Limited; but why is that delightfully quaint, old-fashioned, rambling structure, the "Bell" hotel, not included in the list? The electric light would just complete its many charms.

The engine room has two engines, by Burrell & Sons (who laid out the station and mains), one of 25 H.P., and one of 10 H.P., with two belt-driven dynamos by Laurence, Scott and Co., of Norwich, also a continuous current transformer for charging the accumulators.

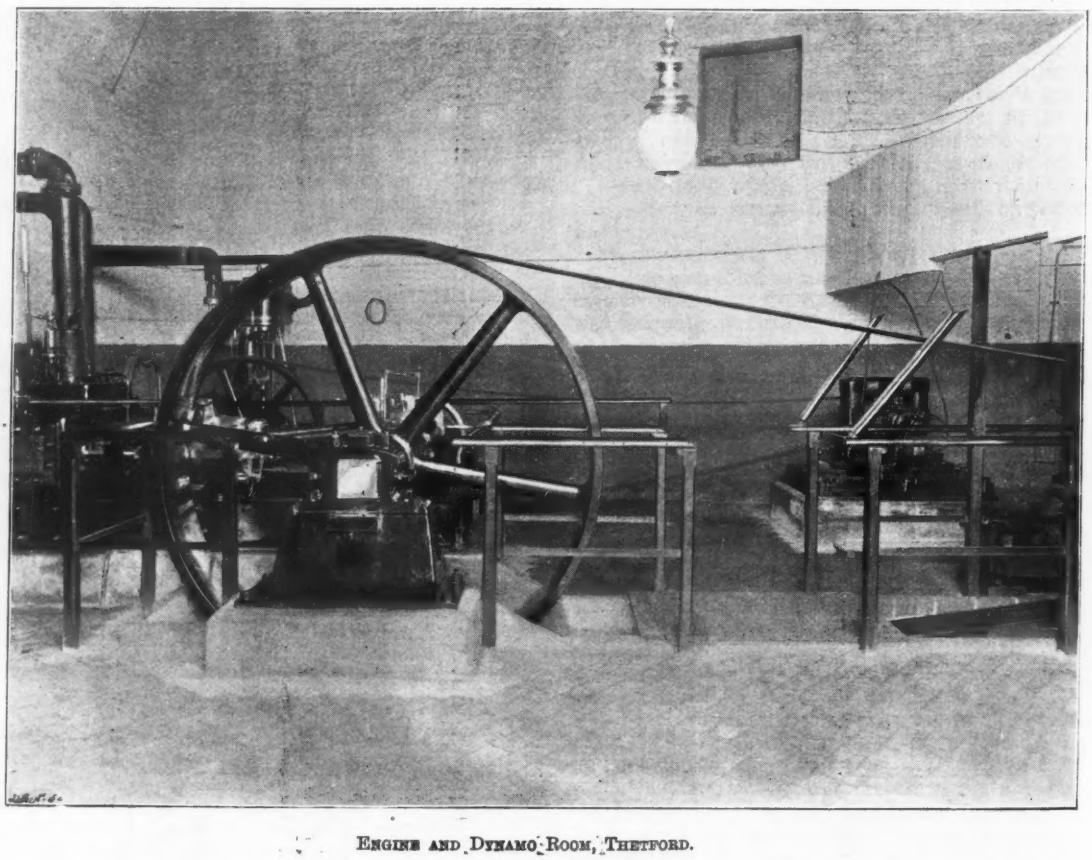
The boiler plant consists of two loco. boilers of 30 H.P. nominal by Burrell & Sons, with feed water heater, duplex Worthington pumps, and a very complete filter plant on the Maignen anti-calcaire principle, which reduces the hardness of the water from 14° to 5°. The accumulator room has a battery of 58 K 25 cells, which have been working since 1892, and still appear to be in excellent condition.

The switchboard is fitted with Ferranti meters, Siemens ammeters, and Laurence, Scott & Co.'s maximum and minimum cut-outs. The system is 110 volts, 2 wire. The lamps, &c., connected up to the time of our visit, were as follows:—

90 Siemens's band arc lamps.
1,200 8-C.P. incandescent lamps (equivalent of)
6 motors of 10 H.P. aggregate.

The charge is 6d. per unit for arc lamps and motors, and 7d. for incandescent lamps.

The secondary cells are employed to give current when the machinery is inactive. The cells have to supply from 10 p.m. until 5 p.m. on the following day, except during the winter months (October to March inclusive), when the plant runs



Engine and Dynamo Room, Thetford.

from 6 a.m. until 8.15 a.m. The whole of the wiring in the town and in Burrell's works has been done by the company.

The directors do not care to publish any figures as to revenue until they are in a position to declare a dividend. At present the profits are carried to a depreciation on plant account.

A good year at Thetford depends very much upon Burrell's engineering works being busy; but the revenue from the town is gradually increasing, notwithstanding the use of incandescent gas.

We are indebted for the information respecting this comparatively small, but successful country town supply, to Mr. R. Carter, the engineer-in-charge (for 5 years in the electric lighting department at Siemens Bros.), who has spent some eight years of his time in a district where hunting, shooting, and sport generally afford some compensation for the quietness of the town.

A brief description here of the lighting of the well known and old established engineering establishment of Messrs. Charles Burrell & Sons, Limited, manufacturers of road locomotives, road rollers, traction and portable engines, steam ploughing and cultivating machinery, thrashing machines, &c., may not be out of place.

In the first instance the electric lighting station was mainly instituted for the purpose of supplying Burrell's works with light and whatever little energy was wanted for motors, and outside lighting was taken on to help the income as far as possible. About five years ago, the works were lighted by gas, such as it was, one department only, and the offices being lighted by incandescent lamps, the sparse way in which these lamps were distributed only serving to make darkness more visible. In the turning shop on a winter's morning, one could see a lot of little peeps of light in a large and imposing mass of darkness, something like one of the earliest maps of the stars. If one looked long and "loud," one could, after a time, discern the figure of a man near each light; each man was supposed to be doing his work by the aid of the light.

The absurdity of the whole thing was so manifest that when Messrs. Burrell moved their machinery into the present shops, they went in for what improvement could be devised. They decided to abandon the plan of one glow lamp per individual and have sufficient arc lamps (well overhead) to light the whole place properly. There is now a very good light all over the shop, especially since the lanterns were taken off and the arc lights used naked. This was done because so much dust gathered in and on the lamps, and the bars of the framework cast shadows on the machines that were troublesome.

We do not know the exact area of the shops lighted, but the lamps are dotted about, say 15 to 25 feet apart and sometimes, perhaps, nearly 30 feet. This is sufficient for the lathe and machine hands to work by, but each of the vicemen has one glow lamp in addition. Several people have thought that the lighting is overdone, but it suits the purpose Messrs. Burrell & Sons had in view admirably, viz.: to have the place filled with light, not darkness. Most of the engineers' shops into which one goes are not, to our mind, well enough lighted, a good many of them, indeed, very badly, so the Thetford firm very wisely determined to avoid this kind of thing.

As to price, there is nothing to exactly compare it with; the cost of lighting is unquestionably higher than the gas bills used to be, because, firstly, there is a very great deal more light used; secondly, since the electric lighting has been in vogue, the firm has done a good deal more overtime; and, thirdly, the price charged per unit has been fixed rather with the view of making both ends meet at the electric lighting station and to have a little over as well. For these reasons it is difficult to compare it with anything previously used; Messrs. Burrell & Sons are, however, quite satisfied with the results.

There are about 80 arc lamps in use connected two in series, taking 6 amperes across 110 volts circuit. At first a lot of lanterns were made at a cost of about 25s. or 26s. each to protect the lamps, but they were all taken down as the men can do better without them. The lamps work very well, giving little trouble. Mr. W. Campbell Wilson, the works manager, informs us that if he were going to arrange the lighting of another workshop to-morrow, he would have more rather than less light. *One can hardly realise the difference it makes in the output of work.*

It may be of interest to know that Mr. I. Burrell, the father of Mr. C. Burrell, sen., chairman of C. B. & S., Limited, fitted up an apparatus for making gas at least 20 years before the latter came into general use in this country, and lighted up his own house, thus being the first to introduce gas for lighting in Thetford. By a curious coincidence, the present Mr. C. Burrell, sen., was the first to introduce the electric light into Thetford, and the present lighting company had its origin in a small 2 H.P. electric light plant fitted up at Mr. Burrell's house, which worked successfully until the advent of the central station.

Assuming there are other towns in the United Kingdom in which a large establishment like that of Messrs. Burrell and Sons constitutes the mainstay of the place, it seems to us that the example set by Thetford is one to be followed with advantage to everybody concerned.

THE USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.*

By F. O. RUSLING.

While the writer was the superintendent of the Buffalo Railway Company, serious indications of electrolysis of the pipes within a half mile of the power-house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter, since there were three systems of natural gas pipes, two of illuminating gas, one of water, and two conduit systems.

Although the pipes were already connected to the negative bus bar by large copper cables, it was found that these were entirely inadequate, and that there were two points where the pipes at heavy load were 3 to 5 volts positive to the adjacent rails. One of these points was 1,500 feet north, and the other 1,800 feet east of the power-house.

The expert calculated that until extensive changes could be made in rail returns, the former point would deliver about 1,000 amperes and the latter about 3,000. To bring this current to the dynamos with but 5 volts loss would need over $8,000 worth of copper. While hesitating over this large expenditure, it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, centre-bearing rails, originally weighing 56 lbs. to the yard, but were worn down to 50 lbs. or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was $8 per ton, delivered. Our expert carefully tested their conductivity with 1,000 to 1,500 amperes, using an instrument reading to $\frac{1}{1000}$ of a volt in order to secure accuracy. As the showing was satisfactory, he persuaded us to let him try the rails on the 1,500-foot length, which would require four rails in parallel to give the desired results.

As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk, and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back, and arranged so that the end of one rail was at the centre of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail, and amalgamating them with the Edison solid alloy.

A steel washer $\frac{1}{4}$-inch thick, $\frac{1}{16}$-inch inside diameter and 4 inches outside, was dipped into hot insulating compound and placed against one rail so as to enclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, enclosing an amalgamated steel spiral spring. The upper rail was then bolted on, and the completed conductor lowered to the bottom of the trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1,500 amperes.

* New York *Electrical World.*

When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather, and has high insulating qualities. It is a product of petroleum and distillation much lighter than asphaltum, and costing about $25 a ton.

This four-rail conduit was connected up, and carried at heavy load 1,100 amperes, 1,500 feet with a loss of but 4 volts. This result was so surprising, that our expert suspected his instruments were wrong, and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the magnificent performance of these old rails and their bonds, I need only say that to give the same result it would require 3·55 square inches of copper, and 1,500 feet of this would weigh 20,532 lbs., and cost at 12 cents per pound, $2,462.83. Our four-rail lengths weighed 50 tons, and cost as scrap but $400.

The resistance of steel as compared with copper is usually considered to be between 7 to 1 and 9 to 1, but this, including 50 bonds in each length, was about 5·63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this even at $30 per ton would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the 14-rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power house is an air compressor for cleaning out armatures and removing dust from the boiler-house walls. An iron pipe was connected from the air reservoir to the yard, and a single layer of rails, bottom up, was put on each waggon. Each load was carried into the yard, and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of $\frac{3}{4}$ inch iron, about 24 inches by 8 inches, were placed in the trough every 15 feet.

These were bored at the ends for a pair of countersunk $\frac{3}{4}$ inch bolts, and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate $\frac{1}{4}$ inch thick, 20 inches by 8 inches. On these more bonds, other layers of four and five rails, and finally a $\frac{3}{4}$ inch by 24 inch by 8 inch top, bolting all layers together. The sides of the trough were but $\frac{1}{2}$ inch from the rails between clamps, so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail-joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the 14 rails transmitted 3,250 amperes 1,800 feet with but 4 volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power-house. The rails used in this conduit weighed about 210 tons, which at $8 would amount to $1,680.

It would require 12·48 square inches of copper to equal the 70 square inches of steel. This copper, figured at 1,000 feet by 1 square inch weighing 3,854·2 lbs. would weigh 86,580 lbs., and at 12 cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3,322, as against $12,852 for equivalent copper. The labour to instal the copper would of course be less, but on the other hand we had the rails in stock, and the only actual outlay was for labour, bonds, lumber, bolts, and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2,500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds, I should not advise the use of buried rails for conduits if copper is used for connections. Even when new it is impossible to get the full conductivity of the rail and the contacts get worse and worse as time passes.

The copper when covered with the damp earth will oxidise at a rate determined by the composition of the soil and the amount of current transmitted.

But following the lines indicated on our second rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost. This subject is well worth careful consideration on the part of railway managers.

A NEW TELEPHONE DISCOVERY.*

By F. JARVIS PATTEN

The above is the title of an editorial in the New York *World* of September 14th. Referring to an alleged Russian discovery, it says: "That by its aid distance is practically abolished, and an ordinary telegraph wire suffices to send music nearly a thousand miles with little loss of tone or volume."

The article then dilates upon the magnificent possibilities that lie in the invention of an automatic telephone "relay" or "repeater," which it is presumed the Russian has discovered.

All this is important if true, but why must these things always happen so far away, and why is it always so difficult to get at any facts in the case?

It is safe to say that we have in this country a thousand opportunities to investigate the telephone repeater problem to one that they have in Russia, and specially developed telephone brains in about the same proportion. We have able inventors familiar with all the conditions of the problem, and in fact all the electricians of the "old school" have had a "hack" at the "Phone Repeater." Edison was at it long ago, but appears to have given it up of late years. We find Moses G. Farmer prominent in the list, and many of those whose early ideas of electricity were acquired at the telegraph operator's table.

The telephone came before the public in 1877, and since that time several thousand United States patents have been issued for alleged telephone improvements, and among the whole lot we find less than 40 patents for telephone repeaters or relays, much less than 1 per cent. of all the telephone inventions patented.

As a matter of laboratory investigation and experiment, I have put all these alleged repeaters into metal, and tried them with a view to determine, if possible, why a telephone repeater or relay could not be made that would *repeat*, and accomplish what the *World* article suggests, namely: Long-distance telephony on ordinary wires, on the same principle that we now have long-distance telegraphy on such wires in daily use for telegraph service.

I have kept close track of this subject for several years, and it is a fact that the telephone repeater is practically abandoned to-day by American inventors, and there is no good evidence that others have any such knowledge of the problem.

My investigation of this subject has been thorough on both the practical and the theoretical side, and my experience convinces me that telephonic repetition from one line to another is destined to be one of the next steps in electrical advance. Last March, I distinctly heard speech in a second line that was automatically transmitted from the first by a repeating telephonic relay, the speech being delivered in the second line with all the distinctness and certainty of ordinary telephonic transmission.

This is, in fact, the essence of telephonic relaying or repetition, for if it can be repeated once it can be done again and again. The instruments were connected in circuit by myself and other electrical experts, who could not be deceived as to the facts, and in view of such facts I am ready to assert that telephonic repetition or relaying of the message is to-day an accomplished fact in the second line, though I am free also to say that I do not think it is generally considered a physical possibility. The instrument and system used, both of which are exceedingly novel and simple, will be described at an early day.

* *Electrical World.*

DATA OF A POWERFUL LIFTING MAGNET.

As an example of a powerful electro-magnet, is shown in fig. 1 an iron-clad design recently constructed and tested by D. W. Hawksworth and H. W. Doubrada, students in the

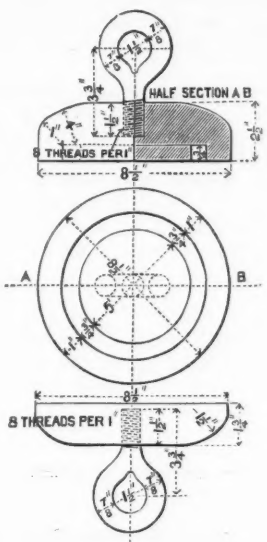
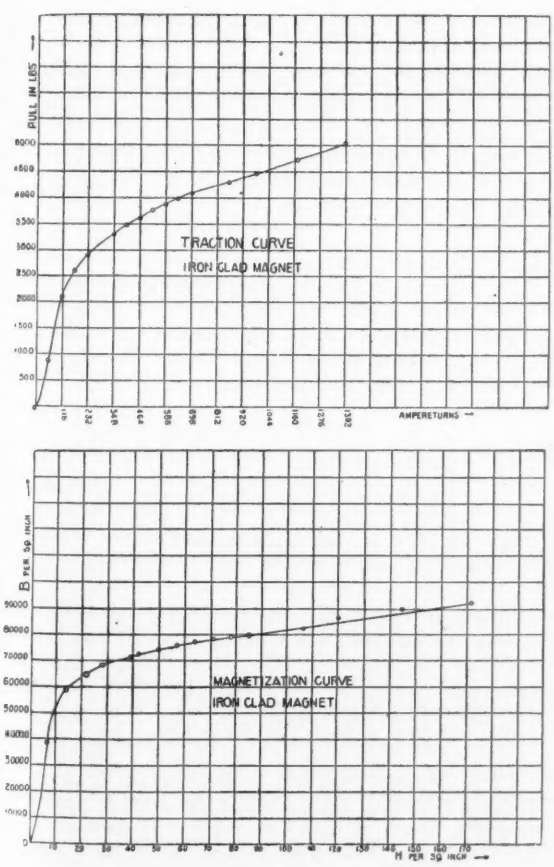


FIG. 1.

electrical engineering department of the University of Nebraska, which is in charge of Prof. R. B. Owens. It was designed for 4,000 pounds pull, with a magnetising force of



FIGS. 2 AND 3.

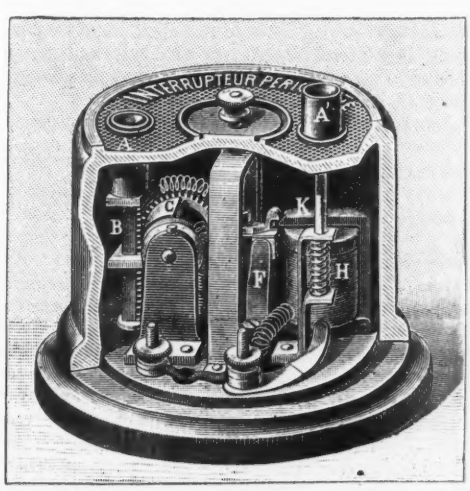
600 ampere-turns. The total weight of the magnet, not including coil, is 33¼ pounds. The coil weighs 17 ounces, and contains 580 turns of No. 24 B. & S. s. c. c. copper wire. The keeper is of the same material as the magnet and weighs 25¼ pounds. The surfaces of the magnet and keeper were carefully turned and scraped to a good fit. The material was a poor grade of wrought iron, sometime used in a locomotive axle. The curve in fig. 2 shows the relation between the pull as measured by a Riehle Bros. testing machine, fitted for the purpose, and the ampere-turns. Fig. 3 shows the magnetising curve as figured from the traction reading. The above data and results of tests were furnished to the *Western Electrician* by the experimenters with the hope that they will be useful to others who may have to design similar magnets.

PRACTICAL ELECTRICITY.

A Periodic Interrupter.

In a large number of electrical installations the lamps placed in the various rooms often remain lighted after the occupants have left them or when they are asleep. In a large hotel, in offices, &c., the number of lamps thus left alight may be considerable. They can be extinguished by opening the general circuit by means of an interrupter placed on the distribution board, but it is no longer possible to supply the electrical energy to the lamps on the same circuit which require it without extinguishing all the others to prevent waste. For various reasons the rooms in question cannot be entered. M. F. Henrion has constructed a periodic interrupter that can be placed in each room. If the general circuit is cut off this interrupter works and extinguishes the lamps. But by a simple pressure the lamps can easily be relighted in any room where they are required. This same apparatus also enables the lamps to be very easily extinguished when they are not required any longer.

The accompanying figure shows the internal arrangement of this interrupter. It consists of a push, A, placed over a rack, B, which catches in a wheel, C, bearing on its axle a metal piece, only one extremity of which is seen in the figure. Two springs tend to bring the wheel, C, back. When we press on A, exercising a certain effort, the metal piece is brought against two spring plates, we see one on one side at F. The current which is conveyed through the two



terminals on the front of the apparatus can then pass through the electro-magnet, H; the soft iron plate, K, is at once attracted, and the little hook which we see fixed to the metal piece mentioned above comes against the plate. The current is then established on the circuit. We will suppose a certain number of these instruments to be placed in various rooms, some occupied, others empty. The electricians see

that a number of lamps are burning uselessly; they cut off the general circuit and re-establish it at once. All the lamps are quickly extinguished. Persons who require their lamps relighted press on A and their lamps only are lighted. If any person wishes to put out his lamp he has only to press on the knob, A^1, which short-circuits the electro-magnet, H, and so effects the extinction.

It is certainly true that this new apparatus supplies a want, and may effect some saving of light, when once the cost of first establishment is paid for; but the question arises as to whether travellers and others will readily submit to being suddenly plunged in darkness, if only for a few seconds, and to being compelled to relight for themselves.

J. L.

THE HEILMANN LOCOMOTIVE.

Our contemporary, the *Bulletin de la Société Belge d'Electriciens*, has an article reviewing the Heilmann locomotive, or rather describing it, for no serious criticism is attempted.

The good things of the engine are all run over, namely, the almost perfect balance of two sets of three-crank engines run as one six-crank machine; the ease of running round curves which arises from the carriage being on a pair of four-wheel bogies, the large adhesion, and the use made of all eight axles. Much is urged in favour of more perfect engines, as by the adoption of the compound system with pressures up to 15 atmospheres; a good deal also is made of the fact that the new engine is to have a grate of 3·34 metres area, or practically 33½ square feet, as against the ordinary French allowance of 2·30 to 2·40 metres. On this point we quite fail to see where the argument comes in. Probably the Belgians, and to common knowledge the Americans, have not hesitated to give this amount of grate area to ordinary locomotives. Many years ago we ourselves measured an American fire-box 9 feet 11 inches long and probably 3 feet 4 inches wide, and much larger affairs are now made. A great point is made, or rather attempted, in respect of the size of wheels and low centre of gravity, though this feature seems worthless. The Americans, who use wheels smaller than we do, have got into the way of placing their boilers so high that we doubt if the C.G. of our English engines is, unless in a few instances, so high as it is unnecessarily placed by the Americans. But the Americans have found, as we have ourselves, that a high C.G. is not dangerous, but that it promotes easy running and helps an engine round curves, and generally is favourable to steadiness, not to name the important point of all, that the lateral shocks on the rail and flanges are diminished, a little item that seems to have no existence with the low C.G. advocates.

If there is a valuable feature in the Heilmann locomotive, it is the power to haul a heavy load up an incline by maintaining the steam engines at a high speed, and working the motors at a heavy torque. All this, of course, demands a large grate area, and it is exceedingly questionable whether on the majority of railways it is worth while to carry so complicated a paraphernalia for the few points of difficulty. We have been told that the Heilmann engine will demonstrate the practicability of electric traction. This indeed was the view of one of our contemporaries special correspondents who investigated the original Heilmann. But this is mere begging of the question. We don't want any proof or demonstration that an electric motor will turn an axle, but we do want to see the steam boiler taken off the road and put into a brick station and electric traction properly attempted. If such ponderous machines as the Heilmann engine are needed, or can be allowed, it would be very easy to arrange six cylinders in horizontal fashion, and use a big grate area, and secure good balance. Ingenious as it may be, the Heilmann engine does not appear to us to be of the nature of a permanent mechanical success. There is a lack of mechanical fitness in the combination, and the ordinary locomotive is so elastic a machine, and works so well over a wide range of speed and power, that its place will be very difficult to fill, unless by the ordinary methods of electrical traction.

REVIEW.

Electricity and Water Power, and their Inter-relations. By Mark A. Replogle. New York: *Electrical Review* Publishing Company, 1896.

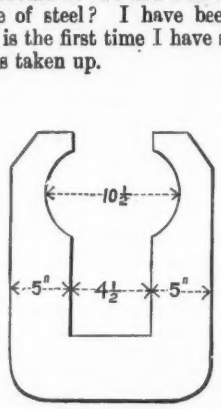
As professed on the title page this little book is intended as a popular exposition for the business man, mechanic, and student of the principles of electrical science and water power.

It is very easy to pull a popular treatise into shreds and to find fault with every term and with every attempted definition. Indeed, it may well be said, the popular definition of the crab as a small red animal that walks sideways, applies to most popular definitions of technical subjects—incorrect in every particular yet conveying as correct an idea as the lay mind seems to be capable of absorbing. It must be very difficult to write a popular book on a subject like electricity and water power. The hydraulic portion of the book consists of descriptions of various electrically transmitted water powers. The mere descriptions are lightened by a sprinkling of Journalese, a little American self worship, and a lapse into prophecy on page 133, but we don't say these things to detract from what is really an interesting and entertaining little book.

CORRESPONDENCE.

Dynamo Design.

I am highly pleased that Mr. Rankin Kennedy is giving a series of papers on simple arithmetic rules for dynamo designing, and so as to thoroughly understand it I have compared it to a dynamo that I know of giving every satisfaction, but I fail to work it out with the tables he gives us. I enclose you the particulars and the results of same, and shall esteem it a favour if Mr. R. K. will apply a table to it to correspond with its results. Does the table act the same for cast-iron magnets as well as wrought or steel, because I understand there should be two and a half times the amount of cast-iron to one of steel? I have been a subscriber for 10 years, and this is the first time I have seen this important matter to amateurs taken up.



This is of Allen's steel, and is 8 inches long in the armature and field magnets; it is wound with ·216 conductors in one layer, ·54 sec. of 4 turns per section No. 11 S.W.G., and when running at 1,050 gives 110 volts 60 amperes. Field magnet 14 layers on each former, 120 turns per layer, and at 110 volts allow 2½ amperes to pass.

Electrician.

[The dynamo described is evidently a Gramme ring dynamo, while the table is made out for drum dynamos whose armature length is not to be less than 1½ diameters. The table is not applicable to dynamos not constructed according to the rules. The dynamo referred to may give every satisfaction in working, but 60 amperes is a very low output, and the efficiency must also be low. The rules and tables when the articles are complete will apply equally to dynamos with cast-iron, wrought-iron, or steel magnets. The dynamo in

question agrees with $n, a, d^2 \times \cdot008$; the excitement is weak for a ring armature, flux is only 450, while the magnets could carry 600 or more.—R. K.]

Would you kindly let me know a few particulars about the following :—

Mr. Kennedy, in an article on the "Designing of Bipolar Machines," gives the formula : $n, a, d^2 \times \cdot015$ = number of watts which ought to be taken from an armature. Again, Mr. Snell, in Prof. S. P. Thompson's book on "Dynamo-Electric Machinery," gives the following : H.P. = $n, a, d^2 \times \cdot00001$ for ring armatures, and $n, a, d^2 \times \cdot000015$ for drum armatures. First, how is it that the spindle does not enter this calculation? Secondly, does the formula given by Mr. Kennedy, divided by 746 = Mr. Snell's law, or, in figures, n = speed, a = length, d = diameter.

$$\frac{n, a, d^2 \times \cdot015}{746} = n, a, d^2 \times \cdot00001.$$

I cannot get my results to equal each other by a great deal, neither can I possibly see why Mr. Snell should use a different constant for a drum and ring armature.

Hoping I have not trespassed upon your valuable space,

Giraldus Jones.

Cardiff.

[In Snell's formulæ and in Kennedy's, the multipliers, ·015 and ·000015, are figures based on practical experience with machines.

Probably every designer uses a multiplier different from others; it follows no rigid law. For cheap high speed machines, ·015 may be chosen for drum armatures; but for a better class of machines ·01 would be used. These articles are written to show the procedure in designing, and not with the object of reconciling one formula with another, nor is it expected that dynamos in general will agree with the n, a, d^2, ·015 formulæ; for instance, no dynamo made from a table calculated on n, a, d^2, ·008, would agree with those made on the table given to illustrate the method of calculation.

The spindle does not form a part of either the magnetic or electric circuits; hence it has nothing to do with the output of a machine.

The formulæ for drum and ring armatures differ, because in a drum the *turns* of wire embrace the *whole* flux, while in a ring each turn embraces only half the flux; a ring armature has higher values for internal resistance, self-induction, and armature reactions of all kinds.

In Kennedy's articles ·015 is the chosen multiplier, because it agrees with many well-known dynamos, and 2,400 has been chosen as the peripheral speed for the same reason; but these two figures are subject to the judgment of the designer. As a general rule the higher the peripheral speed, up to say 4,800, and the lower the multiplier the better the machine.—R. K.]

Lightning Conductors at St. Paul's Cathedral.

In answer to correspondent, "R. S. O.," of the *City Press*, in the Electrical Review, October 16th, 1896. I have read the article you refer to in the *Philosophical Transactions*, 1769; electric conductors were applied at the time.

The committee formed by the Royal Society recommended in 1769 that the metal work of lantern be connected to the lead on dome by means of strips of lead and 1¼-inch square iron bars, the lower portion of lead work on the dome to be connected to the down spouts on stone gallery, the down spouts to roof of nave, &c. Lead down spouts going 3 feet in the ground was considered sufficient to carry away any electricity that may collect on the building. Metal work of the pine apples on the two western towers were connected with the nave roof with 1¼-inch square iron rods, the fall pipes leading to the ground from nave roof were considered sufficient to carry the electric discharge to the ground.

In 1873, I was appointed by the Dean and Chapter of St. Paul's Cathedral to provide efficient protection against lightning for the whole building, and herewith send you an article published at the time by the Telegraphic Journal, August 1st, 1873.

I know of no building in London previous to 1769 that was protected against lightning by a system of conductors.

John Faulkner.

Strangeways, Manchester.

[The article which appeared in the Telegraphic Journal in August, 1873, was headed, "Electricity in St. Paul's Cathedral." It is sufficiently interesting to repay perusal by those who are fortunate enough to have these old copies by them.—Eds. Elec. Rev.]

A Contradiction.

It has come to my knowledge that reports have been circulated that I am acting as consulting engineer to the Mile End Guardians. I shall be obliged if you will allow me to state that such is not the case, as my appointment with Messrs. Crompton & Co., Limited, prevents my acting in such capacity.

B. H. Jenkinson.

Electricity in Mines.

In your issue of October 2nd, you publish a letter from Mr. A. L. Steavenson on the above subject.

In this, he says that he is in entire agreement with Mr. Kennedy as to the efficiency of compressed air plants. This is given as 50 per cent., and even as high as 70 per cent. Now this, I think, is too high.

Mr. Steavenson says :—"Mr. Kennedy has clearly proved that 30 per cent. efficiency for compressed air is too low." Now, I fail to see this; true, Mr. Kennedy has asserted that it is too low, and that 70 per cent. might be obtained by re-heating (which is undesirable, not to say objectionable); but he has not given any instances of actual plants working up as high as this. Taking the ordinary compressing plants at work, and allowing for the usual working conditions, with average losses through leakage, &c., 30 to 50 per cent. seems the utmost that could be allowed in putting down new plant. I think the best answer to this high efficiency claim is the fact that colliery owners who have tried both consider electricity the more efficient, and that many owners are now considering the question of discarding compressed air in favour of electricity.

Besides the first cost of compressed air being higher than electricity, the maintenance is considerably more expensive, and in such work as coal cutting and drilling, it has not the advantage of flexibility that electricity has.

Hydraulic plants have the same disadvantages as compressed air, viz., long lines of pipes, frequent renewals of joints, and consequently, a high cost for maintenance.

I quite agree with Mr. Steavenson as to the advantages of taking the hauling ropes down the shaft for mines not above 600 feet in depth. Mr. Steavenson himself admits that having both boilers and engines underground is objectionable. In that case the choice lies between having pipes down the shaft, with their many joints, large leakage, and in the case of steam, large condensation losses; and having a dynamo at the top and running cables down to a motor. This is certainly more efficient, as is shown by your article of September 18th, describing a hauling plant at Abercanaid Colliery, and by the fact that many collieries are either going in for electrical haulage or are seriously contemplating doing so.

That electric coal cutting is a success, I think may be claimed, as in my experience alone, the results at Lidjett Astley and Tyldesley, Nostell, and Stanton Collieries, have all been extremely satisfactory, and the use of electric coal cutters is extending every day.

I must disagree with Mr. Kennedy when he says that induction motors are the best for mining work, as, not to mention the increased number of leads they necessitate, at present I have not yet seen any that would start with load on, or would stand the heavy overloading met with in both coal-cutting and hauling. They always pull up when slightly overloaded, and this will not do in mining work, where motors are frequently subjected to very heavy temporary overloading.

I think from 300 to 500 volts is a very good voltage to work at. Anything higher becomes dangerous. As for commutator sparking, this, in a well-designed motor, and with proper casing, is no danger at all.

I should like to know what sort of plant Mr. Steavenson had for his lighting, the number of lights for both kinds of illumination, and how he arrived at his £182 7s. 11d. loss.

Of course the difference in cost between well lighting a pit by electricity and poorly lighting it by oil lamps is, as Mr. Steavenson says, quite inconsiderable. I think he will find that electrical machinery now, and the method of putting it down, is an improvement on the work of 1882, and I should say that, apart from the cost of coal, which is of no consequence, seeing that Mr. Steavenson gets his power from coke oven flues, and he will never feel the small amount used up in lighting, he will find that, allowing 5 per cent. interest and 10 per cent. depreciation, the running cost of 100 16-C.P. lamps to be about £50 per annum, including lamp renewals, or 10s. per lamp for continuous running.

H. W. Appleby.

Local Government Board and Eccles.

I read an article in the ELECTRICAL REVIEW of September 11th on the Local Government Board refusing to consent to the town of Eccles borrowing money for the purpose of supplying itself with the electric light, on the grounds that the system they proposed using, and the site selected, was wrong.

You expressed doubts as to whether the Local Government Board has acted rightly in withholding its consent, and you expressed a wish for the opinions of electrical engineers on the subject.

Very curious. I have not yet seen in your influential journal any response to your invitation.

Surely after the varied experience of the last fourteen years or so the opinions of electrical engineers are not expected to continue in a chrysalis state.

Both systems, high and low tension, have been in use for some years. So far as commercial results are concerned, each, to a certain extent, has been successful, although unfortunately for the new industry there have been failures.

The question for any advisory board to decide is which of the two systems is the more likely to pay a return for the outlay, and which of the two, when put to practical use, will meet the general requirements of say Eccles or any town from London downwards.

I think it will be admitted that an electric light station controlled privately, or by a municipality, has the best chance of success when the plant is constructed so as to make sure that it will be in a position to supply, in the most efficient and economical way, current for lighting incandescence and arc lamps; also for power, and if need be, from the same mains.

If such be the requirements of a central electric lighting station, then in that case there can be no difficulty in deciding whether the Local Government Board has acted rightly in withholding its consent.

In fact, the Board, for numerous tangible reasons, could not have acted otherwise, as an inquiry was no doubt made for the purpose of protecting the interests of ratepayers, by seeing that the money proposed to be spent would be used to the best advantage.

The position of a central station would depend upon the system to be used, and if the Board objected to it, as a natural consequence the position of the central station would be wrong.

The town of Eccles, or any town of, say five mile radius, ought not to adopt the high tension alternating current system, for the simple reason that the disadvantages in connection with its use are too numerous to warrant its adoption.

It is dangerous to the lives of the employés. The loss of current in transforming from high to low, overbalances the saving in size of mains.

Arc lamps worked by alternating currents do not give so much light as the same power supplied by continuous.

When you want power to work lifts or light machinery, the continuous currents are by far the most convenient and economical to use.

If you look up the statistics of central stations in this country, or the United States, you will find for the total capital employed the best dividends accrue to those companies who are using the low tension continuous currents.

When you take into account the fact that the three-wire system invented and introduced by Dr. Hopkinson can now be used without paying any royalty, and that you can purchase lamps to work economically to stand a pressure of from 200 to 250 volts, which enables a good-sized town or city to be economically worked up to a pressure of, say, 400 to 500 volts continuous, there is, seriously, no necessity for continuing the use of a system which is shown, from practical experience, to be attended with so many disadvantages.

Lastly, all central stations ought to be ready for emergencies to meet, say, sudden fogs—London ones, or even Scotch mists. High tension A.E.C. does not lend itself to charging accumulators for storage like the safe continuous system.

May I finish by saying we have now an object lesson in the Strand to confirm my views, as the Strand Electric Supply Company is now supplying current alongside the Metropolitan Company's system, for the simple reason that the high tension alternating current system does not meet the requirements of the district.

In making this remark, and mentioning names which ought to be avoided, I wish it to be clearly understood that the fact of two companies being allowed in one district is no reflection on their exceedingly able and highly practical manager, Mr. Bailey, who is the engineer for the Metropolitan Company.

High tension alternating current central stations will never meet the requirements of any industrial district efficiently, as motors ought to be available for use on any floor of any building without causing annoyance to your neighbours, which at present is only possible by using continuous currents.

A. L. Fyfe.

THE SUBMARINE TELEGRAPH MEMORIAL.

THE *Pall Mall Gazette* of October 28th said: "The proposed international memorial 'To the Inception and Extension of Submarine Telegraphy' appears to have created some stir, and a good deal of correspondence in the *Times*, concerning the justice of especially associating with it the names of the late Sir John Pender, Sir James Anderson, or Mr. Cyrus Field. The official letter from the secretary, said to be 'authorised,' but certainly not by his committee generally, sounded very much like dropping a hot poker. We shall be exceedingly surprised if the scientific men whose names have been made use of (on the committee) in connection with this scheme, consider it an honour to have their departed chiefs and fellow workers 'tacked on' to the above three names in any secondary position. It would seem that, if any three names are set up as the pioneers of submarine telegraphy, they should be those of men who have rendered it an accomplished fact by engineering skill and electrical devices, rather than three financiers of this branch of scientific enterprise; the more so when we remember that submarine telegraphy could not possibly be financed until there was something practicable to finance. Lord Kelvin, the late Sir Charles Bright, Sir Samuel Canning, the late Mr. T. R. Crampton, the late Dr. Werner von Siemens, the late Mr. Cromwell Varley, Mr. Latimer Clark, and Mr. F. C. Webb are all pioneers of this work in a strictly professional sense, though none of them has made the large fortunes out of it that the financiers have been able to. We are of opinion that a memorial to such as these would be infinitely more suitable, for it is their early accomplishments which have enabled the capitalists to amass these very fortunes.

"In the event of a memorial being erected to the sister branch of engineering, we find it hard to imagine that Lord Stalbridge, Lord Emlyn, or Lord Tweedmouth—as chairmen of the three largest railway companies—would put themselves in a false light by posing as the pioneers of our railways. And yet there would be just as much sense in this (or in that of immortalising Hudson, the 'railway king') as in putting forward the names of Sir John Pender, Sir James Anderson, and Mr. Cyrus Field as representatives of the inception and extension of submarine telegraphy. Just now civil engineers seem to be having a bad time of it. On the one hand they are constantly elbowed by the Royal Engineers out of work that distinctly pertains to the civilian, and on the other, commercial men show signs of laying claim to glory and honour that certainly belongs to the civil engineer."

We omitted last week to print the following, which appeared in *Truth* of October 15th:—

"Some of the shareholders of the Eastern Telegraph Company are anxious, I understand, to commemorate the services of the late Sir John Pender to submarine telegraphy. I would advise them to be careful that they do not make themselves and the object of their admiration ridiculous. This anybody will certainly do who attempts to place Sir John Pender, Cyrus Field, or any other mere telegraph financier, on the pedestal which properly belongs, not to any capitalist or company promoter, but to the inventors and practical men who developed and worked out the idea—men like the late Sir Charles Bright, Sir Samuel Canning or Sir William Siemens. We

shall hear next that the company-mongers of the railway mania ought to be commemorated for their services in the development of our railway system, rather than men like the Stephensons and Brunels."

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Oct. 27th, 1895.	£	s.
Adelaide	119	0
Algoa Bay	169	0
Amsterdam	25	0
Bombay	10	0
Brussels	62	0
Buenos Ayres	45	0
Calcutta	34	0
Cape Town	2,145	0
Constantinople. Teleg. cable	134	0
Copenhagen	30	0
Demerara	28	0
East London	214	0
Flushing	10	0
Gothenburg	12	0
Melbourne	134	0
New York	28	0
Oporto	17	0
Port Natal	156	0
Rio Grande do Sul. Teleg. mtl.	236	0
Shanghai	998	0
Singapore	6	0
Stockholm	8	0
Trinidad	26	0
Westeras. Teleg. mtl.	82	0
Yokohama ...	11,367	0
Total	£16,095	0

Week Ending Oct. 27th, 1896.	£	s.
Amsterdam	100	0
Antwerp. Electric fuses	50	0
Bombay " "	12	0
"	18	0
Brisbane	65	0
Buenos Ayres	300	0
" " Teleg. mtl.	80	0
Calcutta	220	0
Cape Town	376	0
" " Teleg. mtl.	144	0
Colombo...	21	0
" Teleg. wire ...	120	0
Demerara	10	0
Durban	118	0
East London	130	0
La Treport	18	0
Lisbon	14	0
Melbourne	250	0
" Teleg. mtl.	84	0
Monte Video	33	0
Para. Teleg. cable ...	3,650	0
Port Elizabeth	381	0
Riga	17	0
Rosario	945	0
St. Petersburg. Teleg. material	420	0
Spezzia	140	0
Sydney	387	0
" Teleph. mtl. ...	150	0
Teneriffe	10	0
Wellington	570	0
Total	£8,832	0

Bankruptcy Proceedings.—The public examination of Ronald H. Bridie was held on 16th inst. before Mr. Registrar Brougham in London. The debtor from 1888 to 1891 acted as an assistant to electrical engineers, and he then, with £600 capital, commenced as a consulting engineer in Cannon Street, removing in 1893 to his present offices, 8, St. Benet's Place. His accounts showed total liabilities £2,203 6s., of which £2,149 6s. was unsecured, and assets £41 16s. The debtor attributed his insolvency to losses, amounting in all to about £2,300, incurred during the last 12 months by speculations on the Stock Exchange. At the first meeting a composition of 7s. 6d. in the pound was accepted by the creditors, a claim of £600 by the debtor's mother being released. The examination was concluded.

Liquidation Notices.—A general meeting of the Electric Novelty Syndicate, Limited, will be held at 18, Walbrook, E.C., on Monday, November 30th, at 3 o'clock, to receive the liquidator's report.

At meetings of the Southampton Electric Light and Power Company, held at 23, High Street, Southampton, on September 23rd and October 12th, it was resolved to wind up the company voluntarily, Mr. J. T. Hamilton being appointed liquidator.

A general meeting of the Railway Automatic Electric Light Syndicate, Limited, will be held at 67, Aldersgate Street, E.C., on Friday, November 27th, 1896, for the purpose of having an account laid before them, showing the manner in which the winding-up has been conducted, and the property of the syndicate disposed of.

Belliss Engines.—Messrs. G. E. Belliss & Co.'s engines fitted in H.M.S. *Swordfish*, the new torpedo boat destroyer, have acquitted themselves well. They gave the splendid total of 4,570 I.H.P., which is about 15 per cent. in excess of the contract, this being a record performance for machinery of this description.

Change of Address.—The British Thomson-Houston Company, Limited, have removed from 38, Parliament Street, S.W., to 83, Cannon Street, E.C. The company's London workshops, testing rooms, and stores are now situate at Rose's Wharf, 63, Bankside, S.E.

Mr. Walter Leake, consulting electrical engineer, has removed from No. 30, Victoria Buildings, Manchester, to more commodious offices, No. 51, in the same building.

Claim against the Central London Railway.—The case of Augener *v.* the Central London Railway Company came before the Lord Mayor's Court on Wednesday. It was a claim for compensation for the compulsory purchase of their Newgate Street premises. By consent a verdict was returned for the claimants for £6,200.

Edison-Bell Phonograph Corporation, Limited, v. Hough.—In the Chancery Division of the High Court of Justice, on Wednesday, the 28th inst., this action was down for trial before Mr. Justice Romer. When it was called on, counsel announced that the parties had come to terms; that it had been arranged that the defendant should submit to a perpetual injunction with costs, the inquiry as to damages was to be waived, and all moneys in Court to be paid out to the plaintiff. His Lordship accordingly made an order in the terms agreed.

Froggatt's Electric Lighting Company v. Quentin.—In the City of London Court, on Wednesday, before Mr. Commissioner Kerr, an action was brought by Froggatt's Electric Lighting Company, Limited, Lorrimore Street, Walworth, to recover the sum of £32 13s. 8d., the balance of £115 against Mr. Cecil Quentin, a retired engineer, 23, St. Swithin's Lane, E.C., for work done and materials supplied in equipping the defendant's yacht with electricity. Mr. Commissioner Kerr said the lights did not work properly, and the plaintiffs had never put them right. The consideration for which the defendant had paid his £50 having failed, there must be judgment for the defendant, who might bring an action for damages against the plaintiffs if he was so inclined.

Information Wanted.—Mr. Albert C. Hands, of Garlick Hill, E.C., writes as follows:—"I shall esteem it a favour if you can inform me the name and best makers of 'Sinclair's' solder, and also the best makers for india-rubber solution, prepared tape and strip."

Liberated.—Edward Charles Offer, aged 29, who, as former secretary of the Bournemouth and District Electric Supply Company, has on several occasions appeared in answer to charges of embezzlement, has now been liberated on his entering into his own recognisances in £10 to come up for judgment when called upon. He is stated to be rapidly dying of consumption.

O. Berend & Co., Limited.—Messrs. O. Berend & Co. inform us that the steady growth of their business, and the contemplated extensions of the various departments, have made it necessary for them to increase the capital. They have decided to do this by registering the business as a company, under the style or firm of O. Berend & Co., Limited. The management will remain in the hands of the former partners of the old firm, who will become sole managing directors, while the business will be carried on as heretofore, and all debts due to and owing by the old firm will be received and paid by the new company.

Price Lists.—Illustrated lists of the "Hard" incandescence lamp, Weinert arc lamps, and Messrs. Kücke & Co.'s tools, have been sent to us by Messrs. Wilhelm & Co.

Terminals.—The "J. K." terminal, for which a patent has been applied, is claimed by Messrs. J. Kandt & Co., of 12, Shaftesbury Avenue, who are introducing it, to combine "the acme of simplicity with the essence of utility." By pressing the top and inserting the wires, the latter are immediately held fast, without any screwing. The "J. K." terminals were exclusively used in this year's Berlin Industrial Exhibition.

Verity's, Limited.—Messrs. B. Verity & Sons, of London, Birmingham and Manchester, have converted their firm into a private limited company, under the title of "Verity's, Limited," with a view to interesting certain of their managers, and ultimately of others engaged in the active working of their businesses. No shares will be offered to the public. The firm was established in the early part of the century by Mr. B. Verity, the grandfather of the present owners, and, although some of the earlier ledgers and books were destroyed in 1851, wages books and ledgers dating from 1837 are still in existence. In these many accounts with leading English families can be traced through three and four generations. In the early days many small gas works and gas making apparatus were erected by the firm, who also, it may be mentioned, fitted gas pipes throughout Blenheim Palace in the fifties. On the death of the founder in 1861, the business was partially divided, and the firm of Messrs. Verity Bros. started by two of his sons. This business, however, was again absorbed by Mr. John Verity on their deaths, and "Verity's, Limited," thus take over these two old-established businesses, with the more recently founded businesses of Veritys carried on by the firm in Birmingham and Manchester. The certified number of employés of the firm when taken over by the company was 644, but in view of the large new works now being erected at Aston, this number will soon be very largely added to.

Wigston Electrical and Engineering Company, Limited.—In the High Court, on Wednesday, before Mr. Justice Vaughan Williams, sitting as an additional judge of the Chancery Division, the petition of Taylor and Hubbard, creditors, for a compulsory order to wind up the Wigston Electrical and Engineering Company, Limited, came on for hearing. Counsel stated that the petitioners were creditors for £85. Since they presented the petition, the company had passed resolutions for voluntary winding up, as, by reason of its liabilities, it was unable to continue its business. All the creditors now desired that the voluntary winding up be continued under supervision. His Lordship made a supervision order.

ELECTRIC LIGHTING NOTES.

Ambleside.—A Committee recommended that the Council apply for a provisional order, and for the purpose of going into the matter thoroughly, communicated with Dr. John Hopkinson. The whole Council is now the Electric Lighting Committee, and Dr. Hopkinson has been engaged to report.

Barracks Lighting.—Among other jobs in hand, Messrs. Russell & Russell have the electric lighting of Inkerman Barracks, Woking, for the War Office.

Bermondsey.—The Vestry is sending a deputation to the Board of Trade to ascertain whether they are likely to secure a provisional order. If so, it is proposed to appoint Messrs. Kincaid, Waller & Manville, to report on the matter generally for a fee of 50 guineas.

Bolton.—At the last Council meeting, it was stated that since the putting down of the electric light installation the work of the Gas and Lighting Committee had increased very considerably, and in the near future they would have to adopt the practice prevailing in some other towns—of having separate chairmen of the two departments.

Bournemouth.—The surveyor is to report as to the cost of lighting the principal thoroughfares, also the Lower Pleasure Gardens and the pier with electric light. The question of using incandescent gas has already been considered.

Blackburn.—Last week, a Local Government Board inquiry was held into the application of the Town Council for sanction to borrow £28,000 for electric light purposes, and £10,000 for electric traction. The Town Clerk, after explaining the schemes, said that the following figures showed the increase in consumption of electricity:—Commencement of supply, February 18th, 1895: Number of lamps connected, 3,129; maximum load, kilowatts, 32. Ten months ending December, 1895: Number of lamps connected, 5,915; maximum load, kilowatts, 121; percentage of increase, 266. Year ending December, 1896: Number of lamps connected, 13,000 (estimated); maximum load, kilowatts, 325 (estimated); percentage of increase, 168. Year ending December, 1897: Number of lamps connected, 20,000; maximum load, kilowatts, 754; percentage of increase, 132. Regarding the tramways, the proposition was to supersede the two horse sections only with electric traction, the overhead system being proposed. They had made arrangements with the Tramways Company to pay the Corporation a certain price per unit, whilst the basis of cost to the company was 3d. per car mile for power only. The Corporation and the company were both satisfied that there would be a reasonable profit to each party.

Burton.—The electric light at the Public Library will cost about £250.

Bury.—It has been decided to open the new electric lighting station on November 5th. The work of laying the feeder cables has been completed, and the laying of the distributing cables is all but done in the compulsory area.

Bury St. Edmund's.—It is thought likely that the coming municipal election will be fought partly upon the electric lighting question.

Cardiff.—The recommendation of a Sub-Committee that the electric lighting department shall be a separate department, distinct from that over which Mr. Harpur now has supervision, has been adopted by the Cardiff Lighting and Electrical Committee.

The County Council, on Monday, appointed Mr. Neville Applebee electrical engineer at a salary of £200 per annum, to take entire charge of the electric light undertaking. The salary will be re-considered when the extension works now in hand are completed.

Chester.—The public market and the market annexe is to be wired and fitted for electric lighting, under the supervision of Prof. Kennedy and the City Surveyor. The estimates sent in range from £473 to £772. The Town Hall and Free Library are also to be wired and fitted under the same supervision.

The number of applications received from Foregate Street, and the fact that the flags have to be relaid, has led the Council to decide to lay the electric light mains there, in Frodsham Street, and also City Road.

Darwen.—The Council, after considering the electric lighting question the other day, deferred action until Mr. E. M. Lacey should be present and explain certain technical points.

Dunblane.—Gas here is 5s. 10d. per 1,000. A meeting of local gentlemen was held the other day to consider the advisability of lighting the burgh by electricity. The Hydropathic Company at Dunfermline pay £375 per annum for gas, and they say if the municipality do not supply electricity they must put in their own plant. An electrical engineer who was present at the meeting suggested that the water power of the River Allan should be utilised. The meeting decided to go on with the scheme, provided a capital of £6,000 could be raised.

Dundee.—The question of lighting the Dundee Royal Lunatic Asylum proper and West Green has been before the directors.

Mr. Tittensor, the Corporation electrical engineer, reported to the directors upon the matter. The tenders sent in showed that the cost of the installation would be about £3,000. The accepted tenders are mentioned elsewhere.

Farnworth, near Bolton.—The District Council is advised by a committee to consider the question of applying for a provisional order. This action is consequent upon the proposals of the Bolton Corporation to use electric traction for the trams running between the two towns.

Holborn.—It is stated that the County of London and Brush Provincial Electric Lighting Company has had granted by the Holborn Board of Works "certain facilities required for lighting the district."

Hartlepool.—The Hartlepool Town Council have decided to postpone their application for a provisional order for electric lighting until next year, the local Electric Tramways Company, who had offered to light the town, having agreed to take no further steps in the matter at present. The idea of the Town Council is to have the necessary powers in its own hands.

Hoylake.—The District Council has resolved to apply to the Board of Trade for a provisional order. The Council will, later, consider the advisability of proceeding with the project.

Huddersfield.—When the Town Council was discussing the question of gas *v.* electricity for street lighting, Mr. Inman said the cost of lighting of a certain area of the Central Ward by electricity was £130 13s. less than by gas, the cost by gas amounting to £806 14s. But the question of economy had not been considered by the Committee, who desired first of all to get a better light than gas afforded. Alderman Calvert, referring to a statement of Mr. B. Shaw that the electric lighting works had been subsidised to the amount of £6,000 during the last three years, said the department spent a large amount of money before they began to earn a penny, which was the case with most other departments of the Corporation. He pointed out, however, that in September last year the consumption was between 14,000 and 15,000 units, and up to September this year the increase had been about 52 per cent.

India.—In the contract for the electric lighting of Darjeeling, which, as stated last week, has been given to Messrs. Kilburn & Co., of Calcutta, there is an interesting provision made regarding the time in which the installation shall be completed. If the work is completed by June 1st, 1897, it will receive a bonus of Rs. 1,500/-; if by July 1st, Rs. 1,000/-; or by August, Rs. 500.

Kingswood.—The sum originally asked by Mr. Parfitt for the electric light undertaking was £3,500, this has now dropped to £3,200. The Lighting Committee has decided to recommend that an expert be appointed to "value the plant with a view to purchase or otherwise." We should say that the result will depend very much upon who the expert is!

The Law Courts.—The electric light is now used for lighting all the judges' rooms and corridors. The lighting arrangements were overhauled during the vacation.

Lewes.—Mr. Walker, of London, propounded a scheme for the electric lighting of Lewes before a large public meeting the other day, a number of the members of the Town Council being present. He estimated the cost at £10,000, this including the provision of 4,000 8-C.P. lamps: buildings, £1,500; machinery and plant, £4,000; mains, and laying same, £4,000; contingencies, £500.

Liverpool.—Mr. Charles Rettie, of Liverpool, has just completed the wiring and fitting of the pianoforte manufacturing premises of Messrs. W. H. & G. H. Dresper, 96, Bold Street, Liverpool. There are 58 16-C.P. lights, and one 50-C.P. at the entrance. The majority of these are fitted with very artistic lily-shaped shades of heliotrope colour. Special attention has been paid in these shades to the proper diffusion of the light. Pianos placed on exhibition in the window are fitted with electric light instead of candles. We understand that Mr. Rettie has done a good deal of satisfactory wiring work in the Liverpool neighbourhood, among other places being Messrs. Dunthorne's Rembrandt Art Gallery with about 60 lights, and Messrs. Grindley & Palmer's Art Gallery with 119 lamps.

The Chairman of the Lighting Committee stated the other day that the business of the Liverpool Electric Supply Company was transferred to the Corporation on July 1st, at which date the equivalent number of 16 candle-power lamps connected with the supply mains was 41,500. Since that date application had been made for a large number of lamps, and the electric light had been installed in the Municipal Buildings and St. George's Hall, and by the end of this month it was anticipated that the number of lamps connected with the supply mains would reach 48,500. After careful consideration, the Committee felt justified in reducing the price of electrical energy on October 1st from 7½d. to 7d. per unit, with a special rate of 4d. per unit for power purposes, and for very large consumers. Meter rents had also been reduced from 24s. to 12s. per annum. The new generating station in Paradise Street was approaching completion, and would be at work in the course of November.

Llandudno.—The Surveyor is to make provision on the site of the electric light station for two rooms for disinfecting purposes, and suitable apparatus is to be purchased.

London.—The St. Olave's Board of Works is negotiating with the London Electric Supply Corporation, Limited, to make the necessary connections from their main for the purpose of lighting the board's offices with electric light.

Long Eaton.—The District Council is to consider the advisability of applying for a provisional order. Some members thought the old Local Board had given the powers to a company, but this is to be inquired into.

(*Continued on page* 568.)

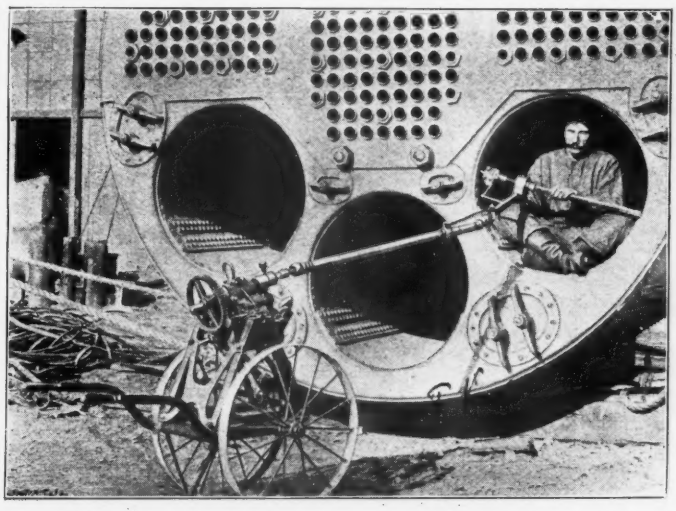
PORTABLE ELECTRIC UNIVERSAL DRILL.

There are few engineers, shipbuilders, or boilermakers who have not felt at some time or other in their experience the need of a reliable portable drilling machine, a very necessary adjunct to modern engineering plant.

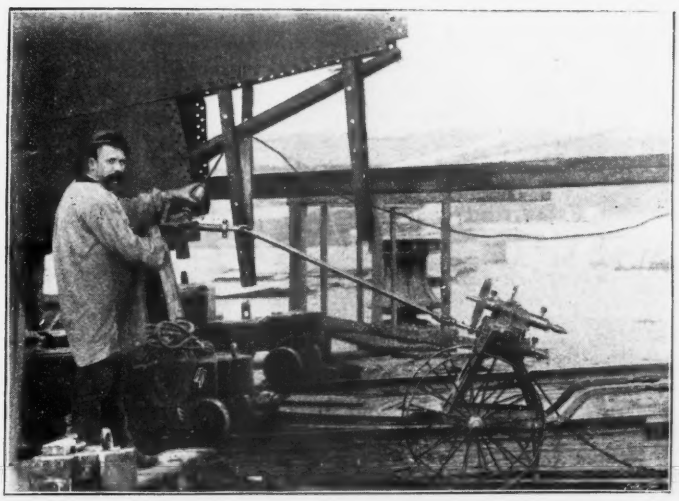
That there are few good types to choose from will not be disputed, most of which possess their own peculiar advantages; but it has been left for Mr. F. Kodolitsch, managing director of the Austrian Lloyds Steam Navigation Company's Arsenal, to put before engineering trades generally a portable drilling machine, in which flexibilty of location and universal utility leave little to be desired.

Portable electric power boring or drilling machines, with the modern extension of electrical transmission of power, may, by Mr. Kodolitsch's machine, be adapted to almost any job, however difficult or inaccessible, and the inventor has developed as many different types of his machine as there are different needs and duties required of them in the engineering trade.

In the arsenal of the Austrian Lloyds Steam Navigation Company, where 2,000 hands are employed, only an exceptionally small number of holes are bored with the obsolete ratchet. A system of electric wires extends all over the place, and each shop is provided with a number of special drilling machines, and the respective cables attached, so that any man requiring to bore holes wheels the small portable drill to the work, and bores the required holes without removing the work, as formerly, when using the fixed drilling machine belonging to the shop. By this means a great deal of time is saved, and in the end money too.



Por able Electric Drill in Boiler Work.



The Bowplates had to be Changed and the Buttstraps Shifted, the Rivetholes for same were Bored in Place.

As in the Austrian Lloyds arsenal all trades are represented, the application of these portable drills is numerous and constantly increasing. The most interesting applications were all photographed, and by the courtesy of Mr. F. Kodolitsch, the patentee of these drills, we are able to place before our readers a series of illustrations showing the various characteristic applications.

In the boiler shop there used to be a special shafting for driving flexible shafts for the American drills. This system, although practical, was very quickly superseded by the application of the electrical boring machines. They proved to be more efficient and much quicker in their application, as it is easier to wheel the boring machine to its place and attach a cable, than to put up the whole gearing, with pulleys and counterweights, which occupies a great deal of time.

For years 10 flexible shaft drills were in use, and now four electric boring machines do the same amount of work with less hands than before. Boring of furnace mouths, fire boxes, &c., are now done by these machines.

In constructing marine engines a great loss of time is produced by the transport of pieces from one tool to another, and it is much more practical to use light portable tools, and bring these tools to the piece of machinery which is to be tooled, than the contrary. For this reason the portable boring machines have proved a great success in saving time and labour.

A big condenser, weighing 24 tons, belonging to a 5,000-H.P. marine engine, was planed on one side, and at the same time all the holes were bored on the other side simultaneously, which proved to be an enormous saving of time, as this heavy piece was put on the planing machine as a rough casting, and was completely finished there, and then put into its place. Even the seats for the air pumps were completely finished with a boring bar driven by one of the electric boring machines.

The application of portable drills in the shipyard is, of course, still more varied and numerous, for these machines can not only be used for boring holes, but also for counter-sinking, cutting out side lights, scuttles, hawse-pipe holes, boring out stern-post bushes by means of boring bars, and when outside plates on the double bottom of a grounded ship are to be changed, all the rivets can be bored out.

On the stem of a 4,000-ton ship all the holes were bored by three of these machines. For boring holes in deck a special machine is made, which can also be used for countersinking. In passenger steamers, where main deck and spar deck have to receive wooden planks fixed by screws, all holes for receiving the wood screws are marked, and the holes bored.

The vertical machine, which has been specially designed for this purpose, can with one man and a boy bore 400 $\frac{1}{2}$-inch holes in $\frac{1}{2}$-inch deck plates in a day. The same machine is also used for countersinking the holes on deck. One man and a boy can easily countersink in a day 800 to 1,000 holes. In countersinking, the hand wheel for feeding the drill is not touched. After the drill is set into its proper position, the man takes the two handles and uses only the machine like a wheelbarrow, and wheels the whole machine from hole to hole, and lifts the countersinking drill out of the finished hole by elevating the two handles, bringing in this way the drill over the next hole and countersinking it by pressing down the two handles, which is a very simple and quick operation.

It is impossible to enumerate all the varied uses to which this machine may be adapted, but we have said enough to show that

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Mr. Kodolitsch has produced a useful machine, and one that he should have no difficulty in introducing to the engineers and others who had long stood in need of this useful invention.

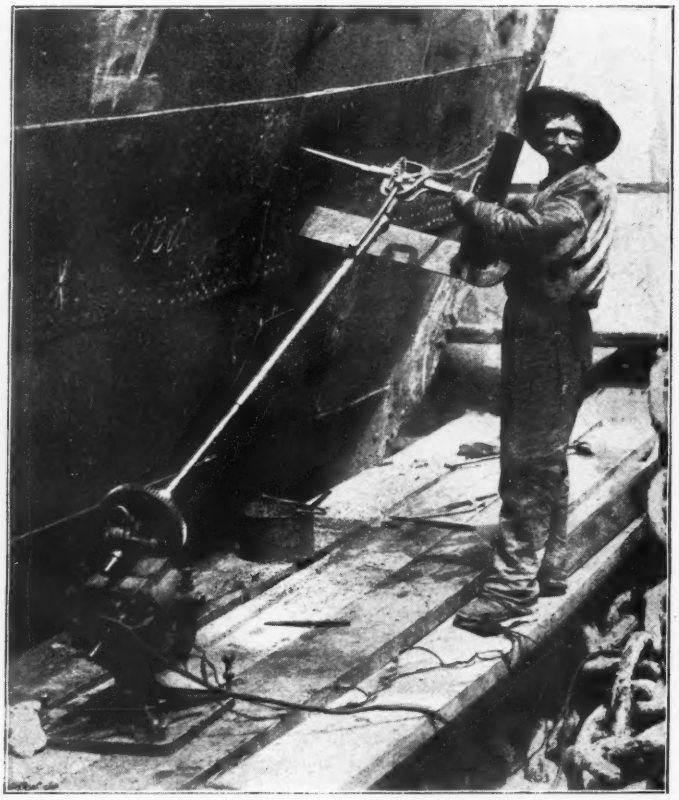
NORWICH CENTRAL ELECTRIC LIGHTING STATION.

The electric lighting in the old city of Norwich is in the hands of the Norwich Electricity Company, Limited, which has made rapid progress, and has from the commencement of working been a financial success. The company was formed in 1890, and obtained a provisional order in 1891. Previous to this, a small pioneer station in Stamp Office Yard had been worked by Messrs. Laurence, Scott & Co., Ltd., electrical engineers, of Norwich, which supplied a few customers by means of overhead wires. This, however, was quite inadequate for the requirements of the company, and Messrs. Laurence, Scott & Co. were instructed to get out plans for the necessary works for supplying the whole city. These plans were submitted to Prof. Henry Robinson, who made several suggestions, and the works, which we recently visited, were rearranged on a fresh site, which at the time became available.

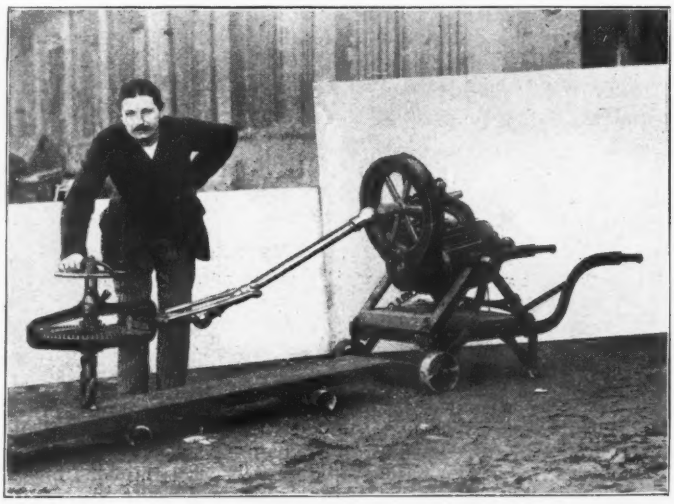
This site is in an admirable position, being on the south bank of the river Wensum, and within 300 yards of the centre of the city.

The method of distribution is the low tension direct current on the three-wire system, with 110 and 220 volts.

The plant at the central station consists of three Willans G.G.S. engines, each of which drives direct two 4-pole Norwich dynamos, supplying current at 110 to 130 volts, the engine being in the centre, as seen in the photo; also three Willans H.H. and two I.I. engines (the second of which has just been erected), which each drive direct one 2-pole Norwich dynamo, giving current at 220 to 250 volts. The G.G.S. engines are used for balancing and for day load, the arrangement of two dynamos on one engine enabling the supply to be maintained with one engine of a fair size instead of two smaller ones, each driving its own dynamo.



Boring Out of Rivets to Change Peaktank Plates which had been Crushed in by Collision. This part of tank was filled by cement, and rivets had to be bored out.



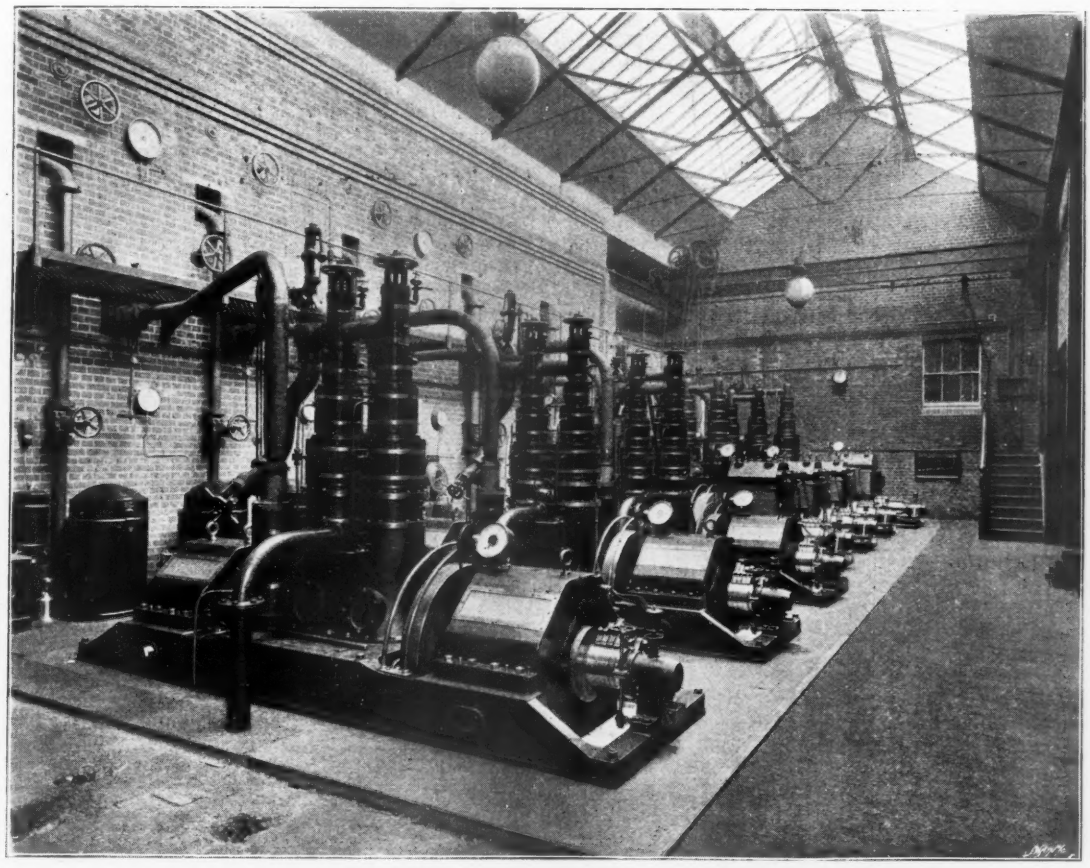
Portable Electric Universal Drill.

Steam is supplied by four Babcock & Wilcox boilers, each of 140 nominal H.P., and 1,619 superficial feet of heating surface. A fifth boiler is now in course of erection, which will be of the same size as the rest, but will have Messrs. Babcock & Wilcox's Scotch furnace, and be fitted with one of their superheaters. Caddy's tubular fire-bars will be used.

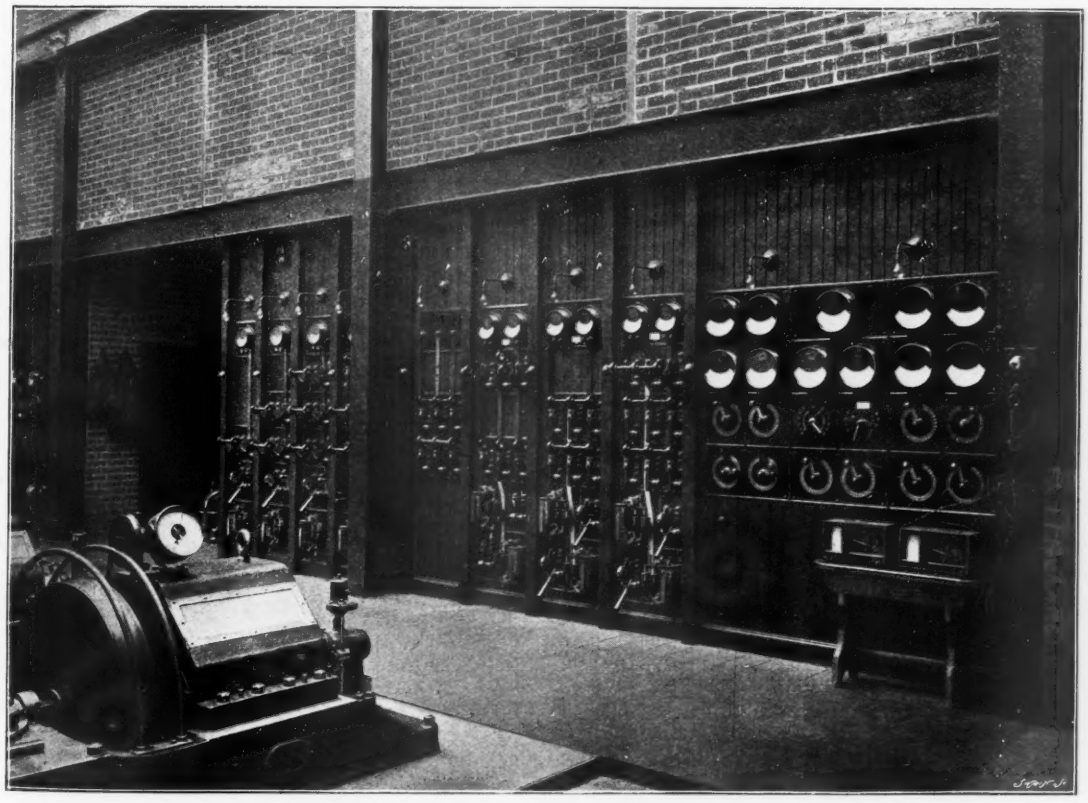
Three compound duplex pumps, supplied by Messrs. Mumford, of Colchester, are provided for feeding the boilers, and an additional compound single Blake & Knowles pump will shortly be put down, which will be available for feeding the boilers or for fire purposes. River water is used for the boilers, and very little trouble has been met with from incrustation. It is first heated to a certain extent in a small feed water tank by the exhaust steam from the feed pumps, and then passed through a Babcock economiser on the way to the boiler.

All the engines are fitted with Körting condensers, which give a vacuum varying from about 27 inches with a light load, to 23 inches with a full load. Water is pumped from the river into a tank 20 feet × 12 feet × 6 feet deep, at a height of 15 feet above the floor, or about 24 feet above the river. This gives a head of about 22 feet above the condensers, and ensures their proper working at all loads. The pumping plant consists of two 4-inch and two 6-inch Gwynne centrifugal pumps, each driven direct by a "Norwich" motor.

A battery of 120 17-plate Crompton-Howell cells is provided, which supplies current for the light load when the engines are not running. Most of the positive plates of these cells have been renewed with Epsteins. The battery room, which is 48 feet long × 7 feet wide, is at one side of the engine room, and 11 feet above the general floor line. It has a concrete floor finished with asphalt, and the space underneath is occupied by the switchboards. The one on the left, as seen in the figure, carries the switches for regulating the charge and discharge of the cells, and just in front are placed the two motor-generators used for charging. These machines have two windings on one armature. The generator winding takes current from the mains, and gives the



Engine and Dynamo Room, Norwich.



Switchboard, Norwich.

extra 20 to 40 volts required for the charge. The motor winding can be supplied with current from the 110 or 220 volts mains through suitable resistances, so that the charging current can be maintained as the E.M.F. of the cells rises.

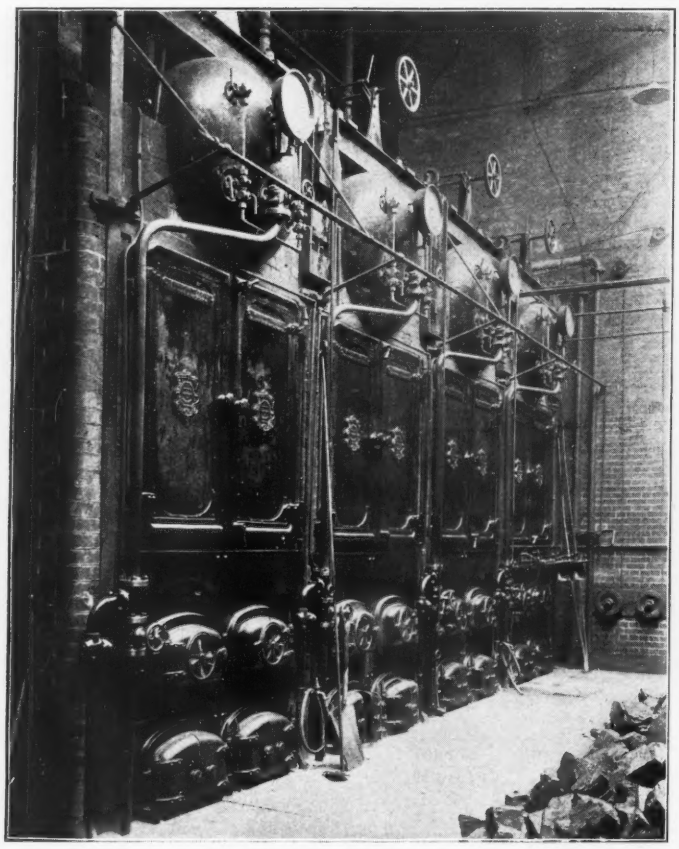
The left hand portion of the main switchboard, as seen in the photo., is divided vertically into separate sections by teak uprights, which form the framework, each of which contains the instruments for one 220-volt machine, or for the two 110-volt machines on one engine. At the bottom of each is an automatic switch, next above this a single-pole switch, and then double-pole or treble-pole switches, so that the machines may be connected on to one or other of the three sets of bus bars running horizontally at the back of the board, and above each is an ammeter showing the current of each machine. On the right-hand portion of the board are arranged the rheostats and voltmeters. Three sets of pilot wires from different points in the distributing network are brought to three pairs of voltmeters, and the pressure regulated accordingly.

The buildings are spacious and well lighted. The engine room is 69 feet long and 27 feet wide, in addition to the space under the battery room. It is traversed by a 5-ton crane, which is worked by chains from the floor. The boiler room is 40 feet wide, giving a space of 12 feet in front of the boilers for stoking, and beyond this are the coal bunkers 20 feet wide. The shaft is square at the base, 7 feet × 7 feet inside, and octagonal above with an ornamental brick cap. The height is 113 feet from the floor line.

Considerable extensions will probably be made next year, and the completed building will be large enough for 12 sets of engines and 9 or 10 boilers.

Mains.—Bare copper is used throughout, except in short lengths, where the available space is too limited, and for distributing mains of the smallest size. Up to the present time about nine miles have been laid, and during the whole period that they have been in use no trouble of any importance has been experienced, and not more than two or three minor difficulties have occurred.

The first 2,000 yards of main were laid in concrete culverts, as designed by Prof. Robinson, but during the progress of the works Mr. Scott, of Messrs. Laurence, Scott & Co., Limited, designed a new system which had the advantage of being considerably cheaper. and also the great merit that the copper was drawn in after the conduit was laid, thus very much shortening the time that the ground was kept open. Additional copper could also be drawn in afterwards, as required. This plan was adopted, and has been used for all mains laid since. The conduit consists of ordinary 6 inch or 9 inch earthenware drain pipes, jointed with cement, with insulators fixed transversely across the pipe every 6 feet. These insulators are about 1¼ inch thick, and are perforated with square holes, through which are threaded the copper strips which form the conductors.



Boiler House, Norwich.

The 6 inch pipes take three conductors, and are used for distributing mains only. The 9 inch tubes take five conductors, two of which are used for feeders, and three for distributors. The pipes are laid in straight lines, manholes being built at every change of direction, or at distances of not more than 80 to 100 yards apart. No. 14 galvanised iron wires are threaded through the holes in the insulators as the pipes are laid, and these are used for drawing through a strong wire rope, by means of which the copper strips are afterwards drawn in. When the strips have all been drawn in, they are well stretched, to take out any kinks, and clamped up, while under tension, against strong insulators at the mouth of the pipes. The several lengths are afterwards connected together in the manholes. A 2 inch or 3 inch pipe is laid at the side for meter wires or pilot wires, if required. About 3 inches of cement concrete is laid all round the pipes, and this has proved quite sufficient protection against injury from picks, &c., no trouble whatever having been experienced on this account.

Ample ventilation is provided by vent pipes against the sides of buildings, &c.

A length of about 300 yards of culvert, some of the first lot which was laid early in 1893, was opened this summer to put in additional copper, and the mains were found to be in as good condition as when they were first put down. A total of about 70 tons of copper has now been laid.

A sub-station with a battery of 124 K 66 E.P.S. cells of about 1,000 ampere-hours capacity has been in operation since the beginning of this year. It is situated in a good residential district, at a distance of 1,900 yards from the central station, and serves to maintain the pressure in this neighbourhood, and supplies current back to the city when the engines are stopped. It is charged during the daytime with current from the central station, through a feeder which is connected to the distributing mains at a point about half way. The pressure is regulated at the central station by means of pilot wires, so that the correct voltage of 110 is maintained at this point. The 6 volts or so lost from here to the sub-station, as well as the extra pressure required for charging, is obtained by motor generators, similar to those at the central station before mentioned. By this arrangement the one feeder can supply current for the sub-station at the far end, or feed into the distributors half way from either end.

Meters.—The method of charging for current is a special feature at Norwich, and is one solution of the problem as to how a fair charge should be made for current, taking into consideration what it costs a company to supply. At the same time it is claimed that this system encourages, as has been the case in Norwich, the use of current at times when some of the machinery would otherwise be standing idle.

The maximum charge is 8d. per unit, but this is only made for current used at time of maximum load, *i.e.*, from one hour before sunset till 8 o'clock in the evening (7 o'clock on

Sundays). During all the rest of the day and night the charge is only 4d. per unit. This is accomplished by making the meters register only half the amount of current used during the latter period. The accounts are made out from the meter readings, all being charged at 8d.

This system was designed by Mr. Scott, and the meters are all supplied by Messrs. Laurence Scott & Co. The meter contains few parts, and is very simple, although it has required considerable time and experience to perfect it.

The current to the lamps passes through two field coils, whose axes are horizontal, fixed on a vertical slate back, between which is suspended a fine wire shunt coil. The shunt circuit is made by a small relay in the meter (which is actuated from the central station) at intervals of 1½ minutes, at the full rate, and 3 minutes at the half rate period, the current being on for about 15 seconds. Making the shunt circuit causes a movement of the suspended shunt coil in proportion to the strength of the field, that is, to the amount of current being used. This movement is made use of to actuate a train of wheels in one direction, either as the coil moves forward on making the shunt, or as it moves back on breaking. The calibration is so arranged that each movement corresponds to the amount of current used in 1½ minutes, and it follows that if the movements take place every 1½ minutes at one time of day, and every 3 minutes at another time, the amount registered in the latter case will be only half that in the former.

The relays in the meters are arranged in series on special meter-wire circuits, the wires passing from one house to another, and so on. Separate circuits are arranged for different parts of the city, and all start from the central station, the current returning by one of the mains. A special clock is provided at the central station, which sends a current through each of these circuits every three minutes or 1½ minutes, according to the time of day. There is also a recording apparatus and instruments to indicate if anything should go wrong with any of the circuits.

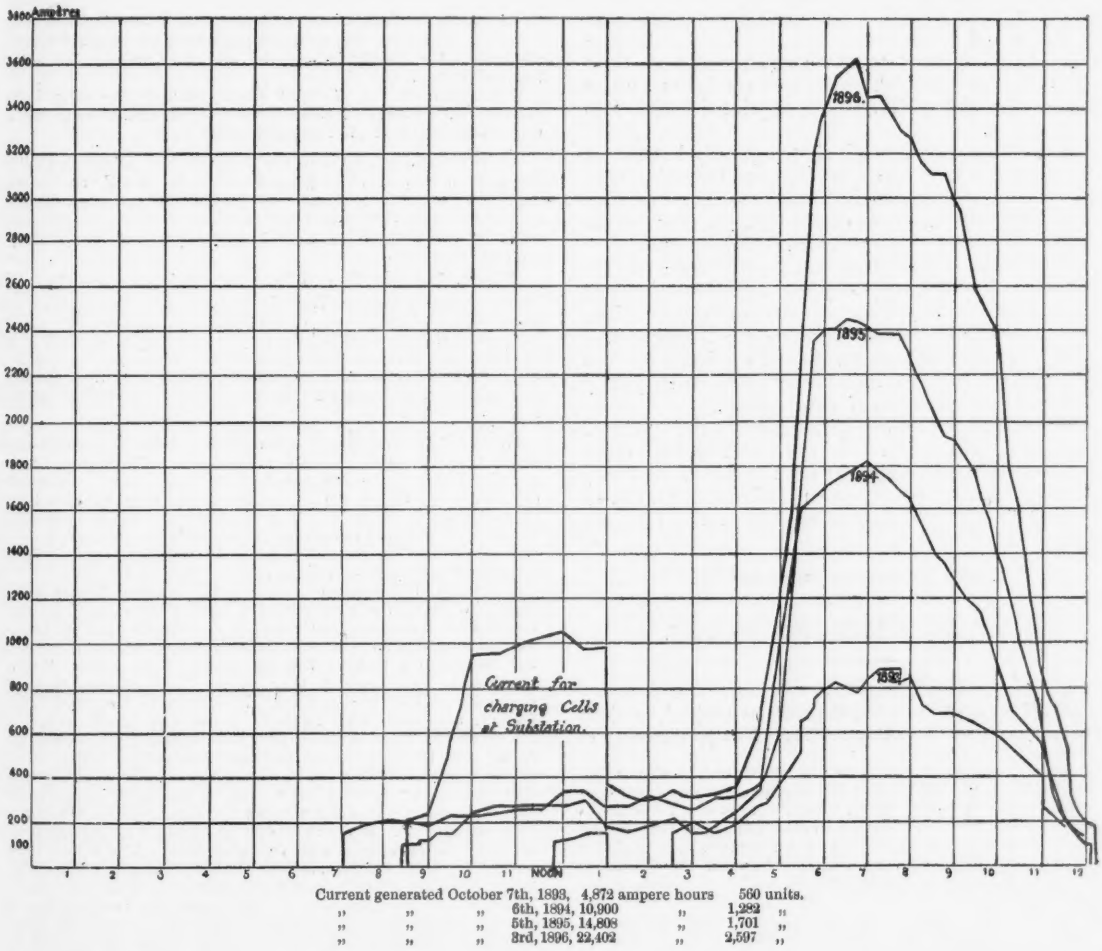
An ingenious arrangement rings a bell and lights a lamp if the working of any circuit is interrupted. There is also a recording apparatus which shows clearly the number of contacts made every hour for each circuit, and registers the time during which full price has been charged. This apparatus, or a duplicate of it, may be placed under separate control.

Up to the end of June the number of consumers connected to the mains was 539, with an equivalent of 134 10-ampere arcs, 9,210 16-C.P. incandescent lamps and 30 motors requiring an aggregate of 44 kilowatts.

The maximum load last year was 3,500 amperes at 110 volts, and this year it is almost certain to reach 5,000 amperes.

The diagram shows the loads for corresponding Saturdays in October for the past four years.

Motors are gradually becoming very popular in Norwich for working circular saws, &c., in carpenters' shops, driving boot and shoe machinery, cream separators, &c. The price of current when the motors are run continuously all day is reduced to 3d. per unit, an ordinary Thomson-Houston or Hookham meter being used, and no extra charge is made at times of heavy load.



Current generated October 7th, 1893,	4,872	ampere hours	560	units.
" " " 6th, 1894,	10,900	"	1,282	"
" " " 5th, 1895,	14,808	"	1,701	"
" " " 3rd, 1896,	22,402	"	2,597	"

There are nine places of worship connected, these being in every case the result of the half-rate after 7 o'clock on Sunday evening, and we look forward to the day when the Cathedral will be included in the list. It is curious to note how lavishly money is expended upon so-called repairs and renovations to our beautiful cathedrals, acts of vandalism in many cases which simply obliterate and destroy all that is left of the original work; but when it comes to using the light which, in its very purity, is best adapted for the artificial illumination of sacred edifices, there are no funds available for the purpose.

The number of private houses is increasing very satisfactorily, it being found that the average cost of electricity is, if anything, less than that of gas (which is 3s. 6d. in Norwich). A considerable number of public houses as well

as places of entertainment, which open after 7 o'clock in the evening, are supplied, and there are also some basements which use current all day. The average day load, not counting the charge current for accumulators, is about 400 amperes at 110 volts.

It should be pointed out that the whole of the electrical plant has been made by Messrs. Laurence, Scott & Co., and this, as well as the engines and boilers, has proved very satisfactory, no breakdown or failure of the supply having once occurred during the three years that the station has been in operation.

The progress of the past has far exceeded the expectations of all concerned, and the prospects of the future are very promising.

Mr. Long, A.M.I.C.E., the engineer and manager, to whom we tender our best thanks for the valuable information we are enabled to place before our readers, was for three years a student at King's College, London, and afterwards went as pupil and then as assistant to Prof. Henry Robinson, Westminster. Whilst there he did a good deal of work in connection with the St. Pancras Vestry Electricity Supply Works. His engagement with the Norwich Electricity Company dates back to the commencement of their building operations in 1892, which were carried out under his supervision. He was afterwards appointed engineer to the company.

It is noteworthy that although all the principal mains in Norwich consist of bare copper in culverts, they have been quite free from the troubles incidental to the use of bare copper in other places. This speaks well, not only for the design of the culverts and insulators, but also for the care with which they have been planned and carried out; and the Norwich Electricity Company may be congratulated on their good fortune in securing an engineer who, by painstaking attention to detail, has reaped for them the advantages of these comparatively cheap mains, without involving them in extra expenditure for experimental work such as frequently accompanies the introduction of new features.

This remark applies with still more force to the system of charging for electric supply, which we think is well worth the attention of engineers who are about to erect electricity works, and are anxious to keep the machinery employed, by cheapening the supply to all consumers alike during the times of light load.

ELECTRIC LIGHTING NOTES.

(*Continued from page 562.*)

Newmarket.—The District Council has resolved, by eight votes to three, to apply to the Board of Trade for a provisional order or license.

In a recent issue we referred to the uproar caused at the last Council meeting, when the electric lighting question was under consideration, by one of the members, who now turns out to be a gas shareholder. We ventured to hope that at the adjourned meeting this individual would have calmed down somewhat. We were doomed to disappointment, for on 21st inst., when the discussion was resumed, Mr. Roderigo, in his speech, said: "As to the electric light prolonging life, he never heard such rubbish in his life." Mr. Segrott attempted to speak, but Mr. Roderigo told him to keep quiet, as he did not know anything about it, and added some personal remarks. The Chairman said it seemed to him that it was the idea of a portion of the Council to throw the order into the hands of a private company. Messrs. Carr and Roderigo: No! No!! The Chairman (speaking warmly): It seems much like it. His further remarks were inaudible in consequence of the high tone of Mr. Roderigo, who was repeatedly called to order, and at last got up and said in an angry tone, "You will get your way; I shall wash my hands of the whole business." He then left the room. How dramatic!

Northwich.—The *London Gazette* of 23rd inst. contains a copy of the application which is to be made to the Board of Trade by the Northwich Electric Supply Company for an electric lighting provisional order.

Oxford.—The progress of the electric light in Oxford during the past year has more than fulfilled the anticipations which were made some 12 months ago. At this period last year some 14,000 lamps were connected to the company's mains. To-day there are nearly 19,000. Mains have been laid during the past year in St. Margaret's Road, two extensions in the Banbury Road, Bardwell Road, New Inn Hall Street, Church Street, part of Woodstock Road, Norham Gardens, and Mansfield Road. A new transformer has been placed in High Street, in the Brasenose College sub-station; another sub-station has just been equipped in North Parade Avenue for the supply of the lights in the residential parts of the city, and a third transformer is at present being placed in the vicinity of Carfax. A considerable addition to the public street lighting has been made; 16 arc lamps have been added to the 16 already in use for lighting the High Street and Cornmarket Street. The candle-power has also been raised from 1,200 to 2,000 candle-power each. The system of arc lighting is completely under control, and is manipulated by several automatic devices, invented by the engineer, Mr. J. Hardie McLean. There are connected to the company's mains a good sprinkling of motors of various powers.

Rotherhithe.—The County of London and Brush Provincial Electric Lighting Company having applied to the vestry for formal consent to the application for a provisional order, the clerk mentioned that eight years ago the vestry sanctioned a similar application by the London Electric Supply Corporation, who had only laid mains in the Rotherhithe New Road. The London Electrical Supply Company are to be asked what they intend doing.

Shoreditch.—The Vestry has agreed to take up the electric light loan on the County Council's conditions, which we have already mentioned.

Sudbury.—The Mayor has seen Mr. E. Clover, of Sudbury Mills, respecting the supply of the electric light, and reports that Mr. Clover has not sufficient power.

Taunton.—The Local Government Board is to be asked to sanction the borrowing of £1,000, in addition to the £300 already estimated, for sundry extensions, &c., this making the amount required £4,000.

The offices of the *Somerset County Gazette* are now lighted electrically, the installation being put in by Messrs. Massingham and Co. There are about 140 incandescent lamps.

Tonbridge.—A special meeting of the District Council was held on 19th inst., to receive a report by Mr. F. H. Medhurst on an electric lighting scheme. He estimates capital expenditure for a 2,000-light installation at about £10,300. The Council decided to apply for a provisional order, and "to confer with an engineer up to a fee of 10 guineas."

Westralia. — The *Financier* understands that the board of the Westralian Electric Lighting and Supply Company, Limited, has recently been considerably strengthened, and that the business in Coolgardie is making very rapid progress, so much so that the demands for the electric light are now in advance of the company's erected plant, but further machinery is on its way to West Australia, and additional contracts are now in the hands of electrical engineers here.

Whitehaven.—Mr. Watts, of the central electric lighting station, having resigned his position, Mr. C. M. Mayson has been appointed electrician-in-charge at £7 10s. per month. An assistant electrician will also be required. The Town Council had a lengthy discussion (?) regarding the new electric light cables (lead-covered this time) which are to be laid by Messrs. Siemens, Brothers & Co., the Council bearing the cost of opening the trenches (£500). Electric light main history at Whitehaven has not been of the happiest. But on the terms of relaying now entered into between Messrs. Siemens and the Council, the former give a further three years' guarantee, and this has influenced the Council in agreeing to open the trenches. Dr. Hopkinson, who is the Council's consulting engineer, must have felt bad at one part of the proceedings. A certain Councillor Cant said he supposed they would have advice when they first entered into the contract. It seemed to him very unsatisfactory, and from what he knew it was very unsatisfactory still. He would like to know where they were getting their present advice from. Did they get it from the same authority as under the first contract, because if they had he should like to know what the value of that advice was. If they had to rely on the same source again—a source of failure—he did not think the committee were doing what they ought to do. It would be very much better if they got someone who stood a little higher than Dr. Hopkinson. The advice received at first had been a failure, and the chances were it would be a failure again, and they would be kept in hot water as long as they were there. The following occurred later in the proceedings:—Councillor Musgrave, in reply to Councillor Metcalf, said they were advised that iron and steel casing was not suitable for this cable.—Councillor Cant: Who were we advised by?—Councillor Musgrave: Dr. Hopkinson.—Councillor Cant: Oh, the same fellow.—The Chairman: Order, order, Mr. Councillor Cant.—Councillor Musgrave thought they must all admit that so far as the cable had gone it was a reasonable and proper one for the work it was called upon to discharge. Will the President of the Institution of Electrical Engineers ever dare to show his face again before such a sturdy opponent and highly technical man as Mr. Cant? We can't imagine why he connects himself with these paltry undertakings.

Wolverhampton.—The Corporation electric lighting scheme is making rapid progress. The sale of current at the present time greatly exceeds that of the corresponding period of last year.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Anticosti.—It is stated that Mr. Menier, the owner of the Island of Anticosti, is importing French steel rails and cars for the narrow gauge electric railway, already begun, which is to be extended 120 miles next spring.

Behr's Express.—A daily press Brussels correspondent says that the first sod of the single-line electric railway at Tervneren, adjoining the grounds of the Brussels Exhibition, has been turned. The Ballybunion line in Ireland, which we have already described, is on a single line system, and the Brussels line is similar, and Mr. F. B. Behr *hopes* to demonstrate there the practicability of his 120 miles per hour system.

Belfast.—The Corporation has, after considering the question of the overhead electric tramway system, thought it better to postpone it until the tramway expert has reported generally.

Birmingham.—The *Birmingham Mercury* is responsible for the statement that in regard to the new Birmingham Tramways Company's proposals, the Public Works' Committee will recommend the City Council to call in an electrical expert to advise them, and it is stated that Mr. F. S. Pearson, an eminent American electrical engineer, has been briefed to visit Birmingham, and examine and report on the situation on behalf of the company.

Bray.—A deputation waited upon the Township Commissioners the other day, consisting of Messrs. Edward Holohan, T.C.; G. M'Cullagh, John Ryan, Thos. Campbell, James Mills, J. Gilligan, J. H. Ryan, C.E.; A. E. Porte, C.E.; Edward Littler, Isaac Molloy (Messrs. Molloy & Molloy, solicitors), with reference to the establishing of electric trams and building a pier at Bray Esplanade. Mr. Molloy, who introduced the deputation, said there had been a numerously signed memorial in favour of making tramways in Bray laid before the Commissioners. It was intended by the promoters to run trams along the Esplanade Road, Quinsborough Road, Main Street, to Town Hall, and branches would also run through Castle Street to Old Connaught, and in the direction of Enniskerry. They intended, after some time, to extend the tramway to Blackrock. The company he represented was the Electric Pioneering Company (?), who had a capital of £100,000, and they were prepared to spend £20,000 or £40,000 in making tramways at Bray. Mr. J. H. Ryan, C.E., said it was proposed to extend the tramway through Novara and other parts of the township after some time. The Chairman asked if overhead wires would be used? Mr. Porte replied that the cost of constructing overhead wire trams was £10,000 a mile, and if underground wires were used the cost would be increased by £3,000 or £4,000 more. They were not, however, tied to any special system, and would be only too happy to adopt an underground wire system if it could be worked at a reasonable cost. The Chairman asked what rent the company proposed to give for the use of the streets? Mr. Ryan replied that the Commissioners should not forget the company were going to pave the streets and keep them in repair. The deputation having withdrawn, it was resolved, on the motion of Mr. Langton, seconded by Sir Rowland Fanning, to ask Mr. Molloy to supply the Commissioners with all plans in reference to both schemes.

Coventry.—The directors of the Coventry Electric Tramways, Limited, on Tuesday decided to approach the Corporation with the view of making arrangements to enable the company to commence the proposed extensions of their line as soon as possible. The company purpose promoting a Bill in Parliament next session which will enable them to extend their system—overhead electrical supply—by about 6½ miles. If the scheme receives the Corporation's support and Parliamentary sanction the company are quite prepared to at once carry it out.

Dublin.—The owner and tenants of houses in Northumberland Road complain of the annoyance caused by the electric tramway sub-station, and think it should be moved! They appear to think it an easy matter to shift such stations. But substations are not, as the man in the street says, "all made to fold up." The complainants had the consolation of knowing that their letter was marked, "read."

The Rathmines Town Commissioners have agreed to apply for a Bill to enable them to build a new tramline from Rathmines Road to Ballsbridge, and to purchase, if thought desirable, the tramlines of the Dublin United Tramway Company within the township.

Dundalk.—The Town Commissioners, at a special meeting last Friday, approved of the proposal to apply for a bill authorising them to put down an electric lighting plant, also to lay down electric tramways, the two schemes being combined in one undertaking.

France.—From November 1st the steam tramways of the Compagnie des Tramways de Paris et du Departement de la Seine running between the Madeleine in Paris and Levallois-serret and Neuilly, will be operated by means of electric accumulators. The central power station is at Puteaux, while the accumulators to be employed are of the Hagen type.

Japan.—In a report to the Foreign Office on the trade of Tokio for the first half-year of 1896, Sir E. Satow refers to electric railway and tramway business in that district. He says:—"Electric railways, which are solely for the commerce of local passenger traffic, have but little practical importance for the foreign merchant, except so far as he is a supplier of electrical plant. Kyoto is already provided with electric tramways, in working order. A line from Kobe to Yuyama, near the hill resort of Arima, is projected. Nagoya and Yokohama have each a plan or plans. In Tokio, electric tramways are only to be permitted as a municipal concern, and progress has been retarded by a recent refusal of the Tamagawa for the generation of the necessary motive power, on the plea that the town water supply, which is drawn from a lower reach of that river, might suffer contamination."

Middlesbrough.—The Streets Committee had the question of electric tramways before it last week. A special meeting is to be held to consider it.

Southport and Lytham.—On 22nd inst., Mr. J. H. Wilkinson, of Chancery Lane, London, presided over a meeting held in the Hoghton Chambers, Hoghton Street, Southport, when a provisional committee was appointed for the purpose of putting into due form, prior to the formation of a limited company, the scheme of Mr. Stewart Speddy, Southport, for constructing a roadway and electric tramway from Southport to Lytham. The estimated cost was put at from £450,000 to £500,000.

South Staffordshire.—A company has waited upon the Dudley Streets and Gas Committee with an offer to acquire their privilege with the view of taking over all the local tramways, including the South Staffordshire tramways, the Dudley and Stourbridge, the Dudley and Wolverhampton, &c., and they proposed to put an electric tramway from Wolverhampton to Kingswinford, from Kingswinford to Stourbridge, then to Cradley Heath, and back to Dudley.

Stretford to Peel Causeway.—The General Purposes Committee of the Ashton-upon-Mersey Council has reported the result of an interview with the representatives of the Manchester Carriage and Tramways Company in reference to the tramway scheme which the company proposed to continue from the terminus at Stretford to Peel Causeway. At the present time it was their intention only to use horse haulage over the proposed tramway line. A deputation representing the Electric Car Syndicate also waited upon the Committee and explained a similar scheme they were proposing to adopt. One member of the deputation pointed out that if the electric car system were established from Stretford to Peel Causeway passengers would be taken on at all costs from Stretford to Manchester. They proposed erecting central poles sixty yards apart, and would arrange to supply the main road with electricity. The wires would not interfere with loads of produce. They proposed to lay double lines along the road. After a long discussion, it was decided to appoint a committee, consisting of Messrs. Kilvert, Lawson and Slater, to confer with the Sale Council to ascertain their views on the matter.

Swansea.—The Corporation has adopted the recommendation to apply for a Bill to empower it to acquire the tramways undertaking upon the terms contained in the agreement between the Corporation and the Tramways Company, the conversion of the line for electrical traction, and a lease of the line so converted to the Tramways Company.

The Underground Stifler.—What is to happen to the very memorable line, the Underground? Doubtless this thought has exercised the minds of many of our readers this week since the reports have been circulated that an American syndicate has made a deal, the object of which is to obtain the control of the whole underground railroad system of London and district. We must not forget that the St. Louis Street Railway Convention has just closed, and this report apparently emanated from one of the delegates. The rumour is a very vague one, and need hardly be taken seriously at present, though Sir William Mackenzie, of Toronto, heads the syndicate, and is supported by capitalists in New York, St. Louis, Toronto, and Philadelphia. But what does the "whole underground railroad system of London and district mean?" The City and South London, the Waterloo and City, the Central London, are all underground systems, either running or in course of construction. We do not think there is much possibility of any one of these undertakings being acquired by Americans. Therefore the remark, to our mind, refers directly to the Metropolitan and District steam lines. What will happen to these lines once Americans secure them? We are not prophets, but we may safely conjecture that there would before long be a very visible improvement, and this improvement would be effected by a change of motive power from steam to electricity. Such is needed, and whether it is done by English or Americans is a comparatively small point. But at present the matter is only "a rumour," and as American press telegrams so often mean the reverse of what they imply, we must await the course of events.

TELEGRAPH AND TELEPHONE NOTES.

Brazilian Submarine.—The report and accounts of the Brazilian Submarine Telegraph Company, Limited (balance-sheet, page 11), to June 30th last, show the expenditure of £17,408 for 1,424 shares of 1,000 marks each in the German Submarine Telegraph Company, which represents, evidently, a call of 25 per cent. If the shares are £50 each, the total amount of capital applied for will be £71,200, which is a very large proportion of the total issue of this "decentralising cable."

Cable Steamship News.—The *Seine* left Halifax, N.S., on the 14th inst. It is rumoured there that she will splice on to the New York shore-end, and lay south; and the *François Arago* will splice on to the Hayti shore-end, and lay north.

Manchester Telephones.—The *Manchester Courier* says that a syndicate has been formed to put on foot a scheme for providing Manchester, Salford, and district with an independent telephone service, in opposition to the National Telephone Company, and comprising the most modern improvements, at rates calculated to bring the benefits of telephone communication within the reach of a greatly extended circle, and, at the same time, to prove sufficiently

remunerative to the company, which is to be styled the New Mutual Telephone Company, Limited. Before the project can be carried out, it will be necessary to obtain a license from the Post Office. It is hoped to charge £6 10s. per annum to non-shareholders.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Para-Maranham	Oct. 8th, 1896 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Saigon-Bangkok	Oct. 22nd, 1896 ...	Oct. 24th, 1896
	Oct. 24th, 1896 ...	Oct. 24th, 1896
Moulmein-Bangkok ...	Oct. 27th, 1896 ...	Oct. 27th, 1896

Telephones in Japan.—It is reported that the Imperial Diet of Japan has agreed to appropriate a sum of 12,800,000 yen for the extension of the telephone service. The work of construction has already been commenced, and is being actively carried on, and it is expected, says a daily contemporary, that the work will be complete by March, 1898, in so far as it concerns Tokio, Yokohama and Kobe, Nagasaki and Shimonoski. A considerable number of branch lines will also be established in places of less importance, so that telephonic communication will be within the reach of a large part of the population of Japan.

Telephoning Across the Desert.—A telephone to the centre of the Sahara strikes one, says the *Daily Chronicle*, at first as an extraordinary undertaking. But it appears that a line has already been installed from Biskra (Algiers) to Tagurd, a distance of 150 miles, and that the wire is to go up to Elbiodth.

The French Telegraph Service.—The Budget estimates shortly to be presented to the Chamber include the following item:—Commerce, posts and telegraphs, 202,147,913 francs.

The Telephone in Russia.—It is reported that it has been decided to erect a telephone line between St. Petersburg and Moscow. The cost of construction is estimated at 400,000 roubles.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—The local Authorities of Bressoux, near Liége, are at present inviting proposals for the lighting of the public streets by gas, electricity, or acetylene.

Dublin.—The tenders for a motor van for the Dublin Bread Company have to be sent in by Friday, November 6th.

France.—The French Post and Telegraph Authorities in Paris are inviting tenders until November 10th for the supply of five lots of Baudot telegraph apparatus. Tenders to be sent to the Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 9th. The Corporation wants tenders for the construction and erection of fans and motors for the new sanitary chambers, Cochrane Street. For further particulars see our "Official Notices."

London, E.C.—Tenders are being invited for the reconstruction of the whole of their lines of tramways, for the North Staffordshire Tramways Company, Limited. Full particulars can be obtained of Mr. J. G. B. Elliot, secretary, 18, Eldon Street, London, E.C.

Madras.—Nov. 11th. Lieut. Col. C. C. Rawson (in charge Consulting Architects' Division) invites tenders for the lighting by electricity of Government House, Madras, including the banqueting hall and the A.D.C.'s bungalow: also for the lighting of Government House, Guindy, including the Military Secretary's bungalow. Particulars to be obtained on application to the Consulting Architect to the Government of Madras, Chepauk, Madras.

Monmouth.—November 2nd. The Town Council invites tenders for the following contracts:—No. 1.—Machinery (consisting of turbines, alternators, steam engines, boilers, electric motors, sewage pumps, &c.); No. 3.—Cast-iron pumping main; No. 4.—Electric lighting mains. Particulars on application to Messrs. Bramwell and Harris, engineers, 5, Great George Street, Westminster, S.W. or to the town clerk, Monmouth.

Roumania.—November 16th. The Municipal Authorities of Bucharest are inviting tenders for the supply and erection of two auxiliary steam engines at the hydro-electric central station at Grozaresti. Tenders to be sent to La Mairie, Bucharest, Roumania.

Spain.—November 17th. Tenders are being invited until November 17th, by the Municipal Authorities of Alcazar de San Juan (province of Ciudad Real) for the concession for the electric lighting of the town during a period of 30 years. Tenders to be directed to El Secretario del Ayuntamiento de Alcazar de San Juan (Ciudad Real).

Torquay.—November 3rd. The Town Council invites tenders for boilers, alternators, pumps, mains, transformers, meters, accumulators, crane, &c., for the electric light installation. Particulars may be obtained of Mr. W. H. Trentham, of 39, Victoria Street, S.W. or the town clerk.

West Ham.—November 24th. The Council invites tenders for four steam alternators, mains, transformers, arc lamps, crane, &c. Particulars from the Borough Electrical Engineer (Mr. John J. Steinitz), Town Hall, Stratford.

CLOSED.

Belfast.—The tender of Messrs. W. Coates & Son for the supply of a complete electric lighting installation to the asylum, for the Governors of the County Asylum Board has been accepted.

Belgium.—Four firms submitted tenders to the Belgian State Railway Authorities in Brussels for the supply and erection of the plant and fittings required for the electric lighting of the railway station at Arlon, as also the locomotive shed and waggon repair shop. The lowest offer was that of the Société d'Electricité (Bouckaert and Co. of Brussels), their tender amounting to 109,549 francs or about £4,382.

Brazil.—The contract for the two engines required for a central station at present being established at Rio de Janeiro has been placed with the Harrisburg Foundry & Machine Company, of Harrisburg, Pa., U.S.A.

Dundee.—The following are the accepted tenders for the electric light installation at the Royal Lunatic Asylum, &c.:—Messrs. Lowdon Brothers, North Tay Street, for the wiring, fitting, engine and dynamo, switchboard, and accumulators, for Westgreen Asylum, and for the lighting of the lodge, Superintendent's house, and grounds, £2,281 17s.; Messrs. M'Farlane & Machan, Dock Street, for the boilers, pumps, and steam piping, £265; Messrs. James Maxwell and Son, King's Road, for the whole of the installation of the electric light at Gray House, including the oil engine, dynamo, switchboard, and accumulators and fittings, £501 15s.

France.—The French Post and Telegraph Authorities in Paris recently invited tenders for the supply of 220 tons of galvanised iron wire of different diameters. The contract has been placed with Messrs. Husson, Thevignot & Co. of Closmortier, near St. Dizier, at 279 francs per ton of 7 mm. diameter wire, 284 francs for 5 mm. and 294 francs to 299 francs for 2½ mm.

NOTES.

Diagnosing the Strength and Internal Condition of Iron Bars.—Every metallurgist knows that there is a very considerable difference of structure in wrought iron and in ingot iron. Wrought iron is fibrous, though it will yield a crystalline fracture when subjected to a sudden tensile strain, for example a jerk, or to a sudden compressive strain, such as a jar. Ingots, however, usually contain blow holes, due to the entanglement of air in the metal as it is poured into the moulds. Sometimes it is due to water-vapour. These are often very considerable. W. F. Durpe, in a paper contributed to the *Proceedings* of the Franklin Institution (1896, Vol. 142, page 110), calculates that when an ingot containing an average number of blow holes is rolled into a bar, a disruptive stress of 132·7 lbs. per square inch may be produced. In unfavourable cases this internal stress may rise very much higher. Internal fracture of the ingots may occur in re-heating, if that operation be rapidly performed, for the expansion of the exterior may set up stresses sufficient to determine the rupture of the central portions. The persistence of such cavities in the finished forging causes mechanical weakness, and flaws of this kind are difficult to detect. It is suggested by Durpe that irregular variation of the electrical resistance of a given bar, tested at different points on its length, might be a means of diagnosis.

Personal.—The *Times* says that Lieutenant-Colonel Wells, R.E., Director of Telegraphs in Persia, an appointment held under the Government of India, has lately been the recipient of a handsome sword of honour "presented by his Majesty the Shah." The distinction is accompanied by a very complimentary Firman, and marks the satisfaction with which the telegraph service and their chief are regarded by the Government of the country.

The arrival in Australia of Mr. John Hesketh, A.M.I.C.E., M.I.E.E., the electrical engineer recently appointed by the Queensland Government, was notified by the *Queensland Electric Telegraph Gazette* in a two-column article, accompanied by a photograph, giving the past history of the late Blackpool electrical engineer.

A Comparative Examination of Some Sources of Light.—An interesting table is given in the *Zeitschrift fur angewandte Chemie*, 1896, page 433, by F. Fischer, which we propose to give without comment. Taking as average costs, spirit, 32 pf. per litre (1s. 6d. per gallon); petroleum, 22 pf., "Kaiserol," 42 pf. (1s., 1s. 11d.); stearin candles, 150 pf. per kilo. (8d. per lb.); coal-gas, 16 pf. per cb. m. (4s. 6d. per 1,000 cb. ft.); and the wear of mantles at 0·5 pf. per 100 candle hours. The author gives from his own and earlier researches (*Zeits. angew. Chem.*, 1891, p 623, and 1895, p. 634 and 665) a comparative table, of which the following is a condensation:—

	Actual light.	Cost per hour	Calculated to 100 candle hours.					Radiant heat per minute on surface of 100 sq. cm. at 87·5 cm. distance for every 8 C.P.
			Consumption.	Cost.	C O produced.	H O produced.	Heat evolved.	
CANDLES.		Pf.	Grms.	Pf.	Kilo.	Kilo.		
Stearin	1	1·3	920	130·0	1·18	1·04	8,100	8·7
Paraffin	1	1·2	770	120·0	1·22	0·99	7,980	8·2
PETROLEUM.								
Flat wick ..	4	0·6	600	13·2	0·95	0·80	6,240	10·8
Round wick ..	25	1·9	330	7·3	0·53	0·44	3,432	10·6
Spirit, incandescent ..	36	3·3	220	9·1	0·38	0·25	1,247	(1·2)
GAS.			cb.m.					
Flat flame ..	12	2·9	1·6	25·6	0·91	1·71	8,480	6·2
Argand	25	4·8	1·2	19·2	0·68	1·28	6,360	6·1
Incandescent	46	2·2	0·25	4·5	0·12	0·21	1,060	1·0
Electric glow lamp	15	4·1	..	27·3	..	..	400	2·2

A Modern Alchemist.—A little flutter of excitement has been aroused in some of the American journals by the announcement that one Dr. Stephen H. Emmens has succeeded in transmuting silver into gold. The name seems familiar to us; we seem to remember it in London some 15 years ago, in connection with primary batteries. It seems that this modern Albertus Magnus is, like his prototype, a sort of universal genius. The editor of the *Engineering and Mining Journal* has succeeded in drawing the genius into a correspondence, in which he shadows forth what it is that he has really discovered; but, of course, he does not give his secret away. The letters which Mr. Emmens has written are a farrago of mysterious nonsense, broken by a few deviations into well-known laws of chemistry. He denies the soft impeachment of being a mere alchemist, yet it is clear that his dreams are very much like Van Helmont's, who was always searching for the *Alcahest*, or universal solvent, whilst Emmens has gone one better, and discovered the *Argentaurum*, or universal raw material out of which Nature constructs both gold and silver. In converting this substance into gold, having first extracted it from silver, Emmens mainly uses "Energy in some of its various forms, such as heat, electricity, magnetism, gravity, cohesion, chemical affinity, X rays, and the like," so that he lays the forces of Nature under considerable contribution. He positively asserts that he can make gold out of silver, and says: "The metal which we have made from silver answers every test to which the United States Government Assay Office subjects the gold offered there for sale. It is, therefore, gold to all intents and purposes. This metal, made from pure silver by the process discovered by us, could be proved to be gold in a Court of law. It not only answers every test of the Government mints, but it also has every quality required by the gold of commerce, having the same colour, weight, and strength." He further says "he has already made 4 ounces of gold from about 6 ounces of silver, and that the loss in the process is about 25 per cent." He was asked if he had himself tested his metal by the United States Government tests for gold, and he replied most positively that "he had, and that it had responded to every test." We suppose that in the course of a few months we shall find this modern alchemist blossoming out into a full-fledged Count of Monte Christo; but for the present he is perfectly content, he says, to be dubbed a crank or a charlatan, or to "receive any other of the pretty names that second-rate scientists are accustomed to employ when faced with what they do not quite understand." We, of course, are therefore amongst the second-raters. We are glad to see, however, that Emmens is not going to give his secret away. He is benevolent enough to wish to avoid the far-reaching consequences which it would bring about to the commerce and finance of the world.

Preserving Meat by Means of Electricity.—There are some people who imagine that electricity is a sort of universal panacea by means of which all the common difficulties of life will be over-ridden, and who consider that whenever any stress of circumstances occurs, they have only to call in the aid of electricity and they will find that every difficulty vanishes. We sympathise with such people, inasmuch as we know that they are on the wrong track. The functions of electricity are limited, just as much as are the functions of any other natural force with which we are acquainted. Amongst the people to whom we may extend our sympathies is one A. B. Pinto, of Rio de Janeiro, who has essayed to preserve meat by means of electricity. The following is an account of his process:—The meat to be preserved is immersed in a 30 per cent. solution of common salt, and a continuous current of electricity is passed through the solution. In from 10 to 20 hours the salting is complete, and the meat is taken out and hung up to dry. In working a bath of 3,000 litres of brine in which 1,000 kilos of meat may be immersed, the current may be of 100 amperes, with an E.M.F. of 8 volts. The electrodes must be of platinum, since if other metals, such as zinc or iron, were used, salts of these metals would be formed, and would be injurious. We sincerely wish Mr. Pinto every success in exploiting his new process for preserving meat. We maintain perfectly open minds as to the success of his venture, but if he can succeed in persuading the world at large that by means of his process he can arrest the progress of putrefaction in a substance like meat, we wish him well, and if he really does succeed in doing this, he will have the satisfaction of knowing that he has succeeded in extending in a new direction the application of electricity.

St. Louis Street Railway Convention.—To use an Irishism, one of our strong points is our weakness for comparing the progress of the United States with that of the United Kingdom in the field of electric traction. If this weakness would but send things ahead we might be tempted to refer to it oftener. The comparison is very unsatisfactory from our point of view, but we live in hope. Our hopes occasionally receive a boom of encouragement, and sometimes these encouragements come from across the Atlantic. From the standpoint of technical journalism, we should say there never was anything like the St. Louis Street Railway Convention issues of the American street railway papers, or at least two of them. This Convention held its meeting from October 20th to 23rd, and in accordance with usual custom the New York *Street Railway Journal* and the *Street Railway Review*—the ordinary issues of which are splendid publications—both signalled this important gathering by printing special souvenir numbers, which in size, general get up, and appearance excel anything of the kind that we have ever seen. The principal feature is a collection of photographs and sketches showing the chief attractions of St. Louis, particularly the electric tramway systems of that town. We have not space to spare to say all that might be said in praise of the work of the editors and printers of these two monthly papers. To be fully appreciated the volumes (for they are volumes in size) should be seen. These are primarily the outcome of the great electric tramway business of the States.

The Determination of the Melting Points of Metals.—In the *Proceedings* of the American Academy there is a contribution from the physical laboratory of the Massachusetts Institute of Technology which has been made wholly, or in part, by means of an appropriation from the Rumford fund. The author of this contribution is S. H. Holman, who, with R. R. Lawrence and L. Barr, have succeeded in determining the melting points of aluminium, silver, gold, copper and platinum, by means of the electrical method which has been devised by Holman. It is impossible to give such an abstract of this method as would convey any meaning to our readers; for in order to properly understand it, it must be read in its entirety, and the demands upon our space are such, that it is impossible for us to reproduce it; we are therefore obliged to content ourselves with noticing that this paper has been read, and informing those of our readers who are interested in the melting points of metals, that it is well worthy of careful study, and can be consulted in the *Proceedings* of the American Academy, No. 11, pages 218 to 233.

"An Electric Farm."—We have frequently had the pleasure of noticing the earnest attempts which have been made in different parts of the world, but more especially in Russia and America, to apply electricity to agriculture and horticulture. At first the experiments were of a very empirical and tentative nature; but latterly they have become very much more scientific, and consequently our knowledge of the action of electricity upon plant life has become much extended. It was only quite recently that we pointed out how the electric light can be used for forcing salads out of season, our suggestions having been based upon the experiments of Prof. Rawson, of Arlington. We regret to see, however, in the *Boston Advertiser* a fearfully exaggerated account of some experiments made by one Thomas Fleming, of Toms River, N.J., who is described as "the first man to possess an electric farm for electric farming." There is nothing to be got but cheap copy in allowing the imagination to run riot, as the writer of this article has done. He describes how a conveniently situated stream was dammed, and the head of water, by means of three turbine wheels, made use of for generating electric power, and then how every operation known to farming and horticulture was performed by means of electric motors. Thus we have such statements as the following:—"Electric motors were attached to the cables, and electric ploughs imported from Vienna (why Vienna?), each cutting six furrows at a time. Ground wires and overhead wires run in all directions. Rakers, harrows, mowers and reapers are all worked by motors, and horses are dispensed with. Seed is sown, and fertilisers spread in the same way. Weeds are killed by dragging a wire netting, heavily charged, over the field, or between rows of plants. Buildings are, of course, lighted by electricity, and the big greenhouse is kept bright night and day. Electricity is applied to plants in two ways, through the soil by means of wires buried about 2 inches, and by powerful arc lights, which act like strong sunlight, being softened by amber globes. Under this continuous action radishes, lettuce, spinach, &c., are manufactured in half the usual time. Radishes 17 inches long and 5½ inches thick have been grown. Flowers thus raised were at first injured in their blossoms, their colour faded in common light; but after reduction and softening of the electric light, this was overcome in a measure. The flowers are double the usual size and brilliancy of colour, but do not retain their beauty in daylight as long as common flowers. For evening use they are all right. The entire farm is also lighted up at night. As soon as the seed is sown, the electric current is turned on the underground wires, germination started, and stimulation continued until the crop is harvested. By careful experiment the increase of production is 50 per cent. above common methods. Heads of wheat and corn are larger, the straw coarser, and kernels heavier than any raised in Western fields. Cabbage 2 feet in diameter, lettuce 3 feet tall, and 2 across the head, egg plants weighing 6 lbs. are other products. The first cost of the plant, including farm machinery, wire and cables, was £5,000; but the daily running costs less than the board of four horses." All this for a paltry initial expenditure of £5,000, with the same cost for up-keep as that which would be expended upon four wretched horses. Who would not have an electric farm like Mr. Thomas Fleming? Surely we shall find agriculturists taking to this form of cultivation immediately. One would scarcely have thought that amongst all the various panaceas suggested for vitalising what is called the dieing industry of agriculture, that electricity should be the chosen and most successful agent. But it is only in America where the cabbages are "2 feet in diameter," the lettuce "3 feet tall," the radishes "17 inches long and 5½ inches thick." In England we are content with less heroic proportions.

Yorkshire College Engineering Society.—We have received a copy of the annual report for 1895-6, also a syllabus for the present session. The following are a few of the items:—

Monday, October 26th, 1896.—President's Address, "Practice with Science," by Henry McLaren, M.I.M.E.

Monday, December 14th, 1896.—"Utilisation of Multiphase Currents in Electric Driving," by Percy Nicholls, B.Sc., Wh.Sc., A.M.I.M.E. (Manchester).

Monday, January 18th, 1897.—"Short Stroke Steam Engines," by J. S. Raworth, M.Inst.C.E., M.I.E.E.

Monday, April 26th, 1897.—Discussion, "Motor Cars." Introduced by Fred. Grover, Assoc.M.Inst.C.E.

Obituary.—It was with feelings of the deepest regret that we briefly mentioned last week the death of Mr. James Henry Greathead. Anyone who has followed tunnelling operations in this country will be well aware that the Greathead system has revolutionised the methods adopted. The great underground electric railway schemes which are interesting the whole of the engineering professions both at home and abroad, have depended in a very large degree upon the genius of Mr. Greathead. The success of the City and South London line, with which he was so closely identified during its construction, has depended upon his patent shield, which ingenious device has enormously facilitated tunnelling work all the world over. Mr. Greathead was also connected with the Liverpool Overhead Electric Railway, and has carried to a successful issue many exceedingly difficult extensive engineering works. His tunnelling system, and other inventions, have been used in Glasgow, Edinburgh, Liverpool, Canada, Australia, and other parts of the world. He was a member of the Council of the Institution of Civil Engineers. Mr. Greathead, who died on 21st inst., had for some time suffered from dyspepsia, but his death occurred unexpectedly.

The death is announced of Mr. Wm. D. Allen, chairman of Henry Bessemer, Limited, at the age of 72 years. He was a gold medallist of the Iron and Steel Institute.

Proposed Engineering Index.—With reference to the decision of the International Conference (held under the auspices of the Royal Society of London) that the "International Catalogue of Scientific Literature," which is to begin with 1900, is to relate to pure science only, applied science being strictly excluded, the secretary, Mr. M. Walton Brown, of the Federated Institute of Mining Engineers, says that this is probably due to the absence of representatives of technical societies at the International Conference. The secretary of the Federated Institute considers that it seems desirable that there should be a conference of technical societies to discuss the publication of a subject-matter index to technical and scientific periodicals. His Institution has had before it for some time the question of the publication of such an index of subjects of interest to mining and metallurgical engineers, and thinks that probably a comprehensive index to engineering and other technical papers would prove more valuable. This suggested conference of technical societies might also consider other questions which interest technical societies individually, but which they are unable to settle satisfactorily owing to want of concerted action.

Technical Education.—The excitement caused by the publication of Mr. Williams's book on "Made in Germany" seems now to have subsided, and there appears to be a danger that, in the reaction, we may overlook the kernel of truth concealed in Mr. Williams's undoubtedly exaggerated statements. Lord Rosebery, however, is determined not to make this mistake. Speaking recently at the opening of the Colchester Technical and University Extension College, he reiterated that there was still a great necessity for improved commercial and technical education to enable us to hold our own with continental nations, such as Germany and Switzerland. "Germany," he says, "has long been 20, 30, or 40 years ahead of us in technical education, and Switzerland at least as much. I am not afraid to confess that I am afraid of Germany. Why am I afraid of the Germans? Because they are an industrious nation, systematic nation, a scientific nation; and whatever they take up, whether it be the arts of peace or the arts of war, they push them forward to the utmost possible perfection, with that system, with that industry, and with that science which is a part of their character." Of the many causes that have been suggested for the recent rapid progress of German industries, we believe, with Lord Rosebery, that systematic and scientific management must take a first place. The Government inquiry into the state of technical education on the continent, which Lord Rosebery suggests, appears to be the best way of settling this important point. When competition makes it every year harder to find employment for our young men of good ability, every facility should be offered by the country for obtaining the best educational equipment. As Lord Rosebery remarks, if a young man is intelligent, well educated, and has a high character, he is pretty sure to get on.

Glasgow University.—The buildings for the new engineering laboratory in connection with the Glasgow University will be commenced early in the spring. Meanwhile a temporary laboratory is being equipped in the present University buildings. The equipment will include a 10 H.P. gas engine, a dynamo, battery of accumulators, and these will supply the light for the laboratory. Instructions have been given by the University Court to Prof. Barr to carry out in connection with this installation a scheme for the electric lighting of the Bute and Randolph Halls. The shafting in one of the rooms will be driven by an electric motor. There will be engineering apparatus of all descriptions necessary for complete laboratory practice. We understand that Mr. J. D. Cormack, B.Sc. (of Glasgow), formerly Lecturer on Electrical Engineering at the Yorkshire College, Leeds, and Mr. H. Bamford, have been appointed assistants in the engineering department.

Smelting Ores by Electricity.—It is announced that Dr. de Laval and Engineer Robsahm, of Stockholm, have obtained from the Swedish Government a concession for the establishment of a company for the smelting of ores in electric furnaces on a large scale. The capital is to be about £833,000. Water power at Trollhattan is to be utilised, and all the de Laval patents for electric smelting are to be acquired.

Sir Albert Rollit.—It is announced that a marriage has been arranged, and will shortly take place, between Mary Caroline Duchess of Sutherland and Sir Albert Kaye Rollit, M.P. Electrical and telephone men, as well as the vast host of the general public by whom Sir Albert is admired and highly esteemed, will receive the news with great interest.

Appointments.—We learn that the following appointments have lately been made by Messrs. P. R. Jackson and Co., of Manchester:—Mr. Pickstone (late principal assistant to Dr. Edward Hopkinson, of Mather & Platt) will act as electrical engineer. Mr. Pickstone, we understand, has been carrying out some important experiments with multiphase motors, tramcar motors, and controller switches. He designed some of the Snaefell mountain railway plant.

Mr. R. S. Portheim, who has had considerable experience with Ferranti plant, has been appointed manager of the electrical department.

The Institution of Junior Engineers.—On Friday, November 6th, at the inaugural meeting of 16th session at the Westminster Palace Hotel, the Presidential Address will be delivered by Mr. A. R. Binnie, M.I.C.E. Chair to be taken at 8 o'clock by the retiring President, Mr. Archibald Denny, M.I.N.A. The following are included in the programme of the 1896-97 session:—December 4th, "Electric Central Station Working," by Mr. P. W. McDougall, A.I.E.E., of Deptford (member). May 7th, 1897, "Electrical Railway Signalling," by Mr. S. M. G. Ferriera, of Bow (member).

Accidental Death.—A ganger, named Bolton, working in connection with the electric light works being built in City Road, met his death under sad circumstances on 17th inst. The jury returned a verdict of "accidental death." A fall was thought to be the cause.

The Gentle German.—Last night's *Pall Mall Gazette* contained the following:—"Sent by the medium of the frugal postcard, this communication received by a Glasgow firm of merchants from a Hamburg concern of dynamo and motor manufacturers, is a good example of German pushfulness and methods of business. It should be noted that the Glasgow house had never had trade associations with the Hamburg concern: 'Sir,—I shall esteem it a great favour if you will kindly oblige by letting me know whether you use dynamos or motors, either for producing electrical or other generating power, and whose make the machines are. At the same time I should thank you to give me on the enclosed card the names of those firms in your neighbourhood possessing either dynamos or motors. It will afford me pleasure to reciprocate your kindness when an opportunity occurs. Thanking you in anticipation of a reply,—I am, &c."

City and Guilds of London Institute.—Prof. Ayrton sends us the following list of scholarships awarded in connection with the present session 1896—97 of this college:—

Clothworkers' Scholarship, £60 a year with free education for two years	L. P. Wilson.
Mitchell Scholarship, £40 a year, with free education for two years	R. S. Potter.
Clothworkers' Technical Scholarship, £30 a year, with free education for two years ...	E. W. Cook.
David Salomons Scholarship, £50	E. W. Marchant.
John Samuel Scholarship, £30...	H. W. Hanbury.
Institute's Scholarships, free education for three years	F. S. Miller. J. I. Hunter. F. W. Fawdry.

Water Power.—Before the Manchester Association of Engineers last Saturday, Mr. T. G. Pardoe read a paper on "Water Power and its Development." He thought such power might be used effectively for electric lighting purposes in a number of small towns in the North of England and in Wales. The inhabitants of these towns, however, did not appear inclined, or did not have sufficient money, to embark on what was for them a new enterprise, and outside capital was necessary for the working of that field. People seemed to think they could have water power for nothing. Apparently they forgot that the much-maligned capitalist required a return for his money, and that the works needed repairs and renewals. Whether power of that kind could be rendered available at a lower cost than power derived from coal was a question only to be solved after close consideration of each individual case, and after careful measurements had been made both of the quantity of water that could be obtained and of the "head" under which it could be applied.

The Japanese Government and Electric Locomotives.—We learn from an Irish daily paper that it is reported that the Japanese Government has decided to replace the steam locomotives at present used on the Government lines with electrical engines. A prominent native electrician has been appointed to visit England, with a view to making extensive purchases of these engines. He is at present in the United States, where he has visited many towns, and inquired of the various local authorities the facts relating to electric lighting. In England he will also visit the great centres of the engine-building industries, and will make inquiries as to the municipal control of public lighting as compared with private control. Our contemporary adds the somewhat ominous remark: "If he visits Dublin his eyes will be opened."

NEW COMPANIES REGISTERED.

Veritys, Limited (49,784).—Registered on October 21st with a capital of £140,000 in 7,000 £5 per cent. cumulative preference and 6,980 ordinary shares of £10 each, and 200 management shares of £1 each, to acquire the business now carried on in London, Manchester, and Birmingham, of "B. Verity & Sons," "Verity Bros.," and "Veritys," to enter into an agreement with J. B. Verity, G. H. Verity, and H. S. Verity, and to carry on the business of electricians, electrical and gas engineers, mechanical engineers, artificers in metal, enamel manufacturers, suppliers of electricity, electrical apparatus manufacturers, contractors, gas and electric light fitters, &c. The subscribers (with one share each) are:—J. B. Verity, J.P., 31, King Street, Covent Garden; G. H. Verity, 31, King Street, Covent Garden, engineer; H. S. Verity, Sandridgebury, St. Alban's, gentleman; J. E. Coles, 31, King Street, Covent Garden, engineer; P. G. Ebbutt, Aston, Birmingham, manager; C. L. Harris, 31, King Street, Covent Garden, accountant; C. S. Northcote, 29, Princess Street, Manchester, manager. The number of directors is not to be less than three nor more than seven; qualification of directors £5,000; of others, five management shares; remuneration, £400 each per annum. Registered by Baxter & Co., 27, Nicholas Lane, E.C.

British Electric Traction Company, Limited (49,855).—Registered October 26th, with a capital of £600,000, in £10 shares, to adopt an agreement with the British Electric Traction (Pioneer) Company, Limited, and E. Garcke, and to carry on the business of carriers of passengers and goods, electrical engineers and contractors, electricians, manufacturers of and dealers in railway, tramway, electric and other apparatus, and suppliers of electricity. The subscribers (with one share each) are:—Earl of Suffolk and Berkshire, Charlton Park, Malmesbury; C. W. Fremantle, K.C.B., 12, Buckingham Palace Gardens, S.W.; C. R. Wilson, G.C.M.G., C.B., 21, Pont Street, S.W.; E. Garcke, 1 and 2, Winchester Street, E.C., electrical contractor; G. Herring, 1, Hamilton Place, W.; J. B. Braithwaite, jun., 27, Austin Friars, E.C., stockbroker; J. C. Bull, 1 and 2, Great Winchester Street, E.C., secretary. The number of directors is not to be less than five, nor more than eight. The first are:—Sir C. R. Wilson, Earl of Suffolk and Berkshire, C. W. Fremantle, J. S. Raworth, and E. Garcke. Qualification £500; remuneration for 1897 £2,000 per annun, for 1898 £2,500, and afterwards £3,000 per annum, divisible. Registered office, 1 and 2, Great Winchester Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woodfield Syndicate, Limited (34,037).—This company's annual return has just been filed. The whole capital of £12,000, in £1 shares, has been taken up, the full amount called, and all calls paid.

Vaughan & Brown, Limited (43,247).—This company's annual return was filed on August 14th. The capital is £40,000, in £5 shares, of which 4,000 are preference; 2,849 preference and 2,630 ordinary have been taken up, and 2,000 of each are considered as paid; £5 per share has been called on the rest, and £7,395 has been paid.

CITY NOTES.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

The ordinary half-yearly meeting of this company was held at Winchester House on Wednesday last, the Marquis of Tweedale in the chair. After referring to the loss the company had sustained in the death of Sir John Pender, the chairman said the shareholders will have learnt with great satisfaction that it is proposed to commemorate in some suitable way the great services rendered by him to the country in connection with the extension of submarine telegraphy throughout the world. After referring to his own appointment as chairman, he said the gross revenue for the half year under review has amounted to £313,914, against £264,138 for the corresponding period of 1895, showing an increase of £49,776. This large increase is mainly due to the heavy gold mining traffic with Western Australia, which now represents a very considerable proportion of the Australasian traffic. The working expenses have amounted to £87,256, against £95,254 for the corresponding period of 1895, showing a decrease of £7,998 caused by the cable repairs for the past half year having been exceptionally light. This will, however, be more than counterbalanced during the current half year, our maintenance ships having been almost constantly engaged on repairing work since June 30th. It will be seen from the printed report and accounts that £20,000 has been transferred from the revenue account to the fire insurance reserve fund. As you are aware, the company underwrites three-fourths of the fire risk on its property abroad, which is valued at about £125,000. Consequently, after making this addition, the fund is none too large to meet possible contingencies. The usual interim dividends at the rate of 5 per cent. per annum have been paid for the past half-year, amounting to £62,500, and after transferring £75,000 to the general reserve fund, the balance of £33,235 is carried forward. The result of the fifth year of working of the Australasian tariff arrangement, like the previous year, shows an excess over the guaranteed figure, so that the Governments interested have not been called upon to contribute anything towards the guarantee for the last two years. This satisfactory state of things is due to the development of the gold mining industry in Western Australia already referred to. At the last meeting I referred to the proposed revision of the company's local rates. This revision took effect on July 1st last, and gave much satisfaction to the telegraphing public. Your directors have since considered it advisable to make substantial reductions of tariff between India, China, Japan, &c., so as to meet the requirements of the large trade that is growing up between these countries, and at the same time prevent the traffic being diverted to the landlines through Burmah and Yunnan, upon which very low rates have been fixed. It has also been found necessary to reduce most of the company's *through* rates, in order to harmonise them with the new China tariff fixed by the Chinese agreement, and to which I shall presently more particularly refer. Most of these reductions will come into operation on January 1st next, and the remainder on July 1st, 1897, when the Buda Pesth Conference Regulations take effect. The estimated loss, if no increase of traffic results from the reductions, is roughly at the rate of £80,000 per annum; but it is hoped that the initial loss will soon be diminished, and eventually recouped by increase of business. Apart from tariff changes, the principal features of interest in connection with the recent Conference were:—1. The extension of the 10-letter limit for words in plain language used in transmission of extra European telegrams to 15 letters. 2. The extension of the three-figure limit to five figures for cypher telegrams; and 3. The postponement of the introduction of the proposed official vocabulary until after the next Conference. Many objections had been raised to the vocabulary on the ground that the number of words was inadequate to meet public requirements, and that many of them were unsuitable, and the decision of the Conference has been well received. As you are aware, the company, in concert with its partners in the China and Japan traffic, the Great Northern Telegraph Company, has for many years past endeavoured to arrange a friendly working agreement with the Chinese Telegraph Administration, and since 1893, when the Chinese landlines were joined to the Russian telegraph system, the Administration have competed with us for the European and local traffic. As far back as 1887 an agreement was actually signed by the Chinese and companies' representatives, but owing to difficulties that arose in connection with its ratification, it was never carried into effect. Recently, however, we have been more successful, our negotiations having resulted in a satisfactory working agreement, which was duly ratified by all the interested Governments on July 31st last, and brought into operation the following day. The arrangement is based on the pooling and division of the receipts from the China traffic, and the collection in Chinese currency of a fair equivalent of our sterling charges, thus settling the troublesome question of "Exchange" from which we have so severely suffered for many years past. The increased rate of collection introduced on August 1st has evoked a good deal of unfavourable comment on the part of the local Chambers of Commerce, press, and telegraphing public generally, but as the company was carrying the China homeward traffic for next to nothing, and the telegraphing public of China was paying only about 4s. 6d. per word, instead of the proper rate of 7s. as charged on this side, it will be seen that there is no just ground for the agitation against the company's recent action. The Imperial Commission—to consider the question of laying an "all-British cable" across the Pacific—was duly opened in June last, but only one sitting was held before the Commission adjourned for the vacation. It is expected to reopen very shortly, when the question will doubtless be exhaustively considered. The tariff advocated for the proposed Pacific cable between Europe and Australia is 3s. per word, as against the existing rate of 4s. 9d. You will, however, remember that this rate was fixed by the Australasian Governments themselves when arranging the tariff guarantee agreement with the company, and cannot, therefore, be considered unreasonable or excessive. If, however, we were to reduce the rate to 3s. as proposed, it would involve us in a loss based upon the present traffic of about £157,000, without making any allowance for diversion of traffic. Should, however, half of the existing traffic be diverted to the Pacific cable, as anticipated by its advocates, our loss would probably be increased to £266,000 The chances were altogether in favour of their retaining the larger proportion of traffic, more especially as the Western Australian traffic is bound to come by our lines. I do not dwell on these matters with a view to creating anything like alarm, but rather to explain and justify the policy we have pursued in building up a large reserve, and thus enable us to meet competition from whatever quarter it may come.

After some discussion, it was decided to leave the question of contributing to the proposed memorial in the hands of the directors.

Brazilian Submarine Telegraph Company, Limited.

The half-yearly general meeting of the Brazilian Submarine Telegraph Company, Limited, was held on Wednesday at Winchester House, Mr. J. Denison Pender presiding.

In moving the adoption of the report, the Chairman said that the strong position of the company was clearly shown, and he saw nothing in the future to diminish its prosperity. The receipts from messages, £92,071, showed a decrease of £14,097, as compared with the previous year; but this decrease was due chiefly to unavoidable, and, he hoped, temporary causes. Among these might be mentioned the fall in exchange in Brazil, the dulness of trade, and keen competition in the River plate district, causing fewer messages to be transmitted; while Press messages had increased, entailing much work, but not much additional revenue. Most of the commercial messages averaged only a little over nine or ten words. Above all, the decrease in revenue was due to a reduction of 6d. per word having been made in the messages to South America last year. On the other hand, their expenses were £19,210, a decrease of £2,413, due to the absence of any expenditure for the repair of cables, which in the previous year cost £2,770. The dividend and bonus to be paid out of profit equalled 7 per cent.—the same as in the preceding year, and their reserve fund now stood at £832,000. Mr. Youle seconded the motion, which was agreed to.

Stock Exchange Notices.—The Stock Exchange Committee has appointed Wednesday, November 4th, a special settling day in the following:—British Aluminium Company, Limited—3,230 vendors' 7 per cent. preference shares, Nos. 11,304 to 14,533; and a further issue of 467 7 per cent. preference shares, fully paid, Nos. 14,534 to 15,000, and 5,000 7 per cent. preference shares, £4 paid, Nos. 15,001 to 20,000. Charing Cross and Strand Electricity Supply Corporation, Limited—10,000 4½ per cent. preference shares, Nos. 1 to 10,000.

Application has been made to the Stock Exchange Committee to appoint a special settling day in, and grant a quotation to—Milwaukee Electric Railway and Light Company—$5,500,000 5 per cent. 30-year consolidated mortgage gold bonds of 1926, Nos. 1 to 5,500.

The Western and Brazilian Telegraph Company, Limited.—The directors have decided that after placing £5,000 to the Debenture Redemption Fund, and £3,000 to the Reserve Fund, the directors would, subject to audit, recommend, at the forthcoming meeting, a dividend at the rate of £2 per cent. per annum, free of Income tax, for the six months ended June 30th last, carrying forward £3,530 5s. 7d.

Callender's Cable and Construction Company, Limited.—The directors have declared an interim dividend on account of the current year at the rate of 4s. per share, equal to 8 per cent. per annum.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 25th, 1896, were £1,003; week ending October 27th, 1895, £977; increase, £26; total receipts for half-year, 1896, £15,696; corresponding period, 1895, £14,678; increase, £1,018.

The Liverpool Overhead Railway Company. The receipts for the week ending October 25th, 1896, amounted to £1,092; corresponding week last year, £1,075; increase, £17.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 23rd, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,432.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Oct. 21st.	Closing Quotation, Oct. 28th.	Business done during week ended Oct. 28th, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	103	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	49 — 52xd	50 — 53	51½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	95 — 96xd	95½ — 96½	96	95
2,993,560£	Do. do. Defd.	Stock	...	...	...	8¾— 9½	9 — 9½	8 15/16	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	7 %	14¾— 15¼	14¾— 15¼	15¼	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	5 %	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	4 %	3½— 3¾	3½— 3¾	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	145 —150	145 —150	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½— 12½	11½— 12½	12 5/16	12¼
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	107 —110 %	107 —110%	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	2½%	9¼— 9⅜xd	9¼— 9⅜	9¼	9¼
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	6½%	17½— 18xd	17¼— 17¾	17⅞	17¼
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	18½— 19¼xd	18½— 19¼	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	131 —134	131 —134	133	132
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½— 18xd	17¼— 17¾	17 13/16	17 5/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 - 104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	130 —133	130 —133	133	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	110 —113 %	110 —113 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	4½%	10⅜— 11¼	10⅜— 11¼	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17½— 18	17¼— 17⅞	17⅞	17⅜
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	24 — 25	24 — 25	24⅞	24¼
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	52 — 55	52 — 53	54¼	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	4 %	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	7⅛— 7⅜	7⅛— 7⅜	7⅜	7 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	18½	18
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅜— 7	6⅜— 7	6 15/16	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —109	106 —109	107½	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	11/16 — 13/16	11/16 — 13/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	7 — 8xd	7 — 8	7½	...
3,361	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3½— 4	3⅜— 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	101 —106	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	5 — 6	5 — 6	...	...
238,360£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	102 —105	102 —105	...	...
36,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	½ — 1½	½ — 1½	...	...
156,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	98 —103	98 —103	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	7⅞— 8¼	7⅞— 8¼	8	7 13/16
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6¼— 6⅝	6¼— 6⅝	...	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	1⅜— 2¼	1⅜— 2¼	...	...
165,200£	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	7/8%	¼%	7/8%	1⅛— 1⅜	1⅛— 1⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11½— 12	11½— 12	11⅝	11¾
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	110 —115	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —105	100 —105	102½	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½— 10	9½— 10	9 11/16	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7⅞— 8¼	7⅞— 8¼	7⅞	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	16 — 17	16 — 17	17	16¼
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17 9/16	...
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —135	130 —135	132	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	*nil*	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	...	6 %	13⅜— 14¼	13⅜— 14¼	13⅝	...
10,000	Do. do. iss. at 2 pm., all paid	10	...	...	...	5½— 6½	5½— 6½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	13 — 14xd	13 — 14	13⅛	...
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	3½— 4½	3½— 4	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 —124	121 —124	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	11½— 12½	11½— 12½	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	11½— 12½	12 — 13	12½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	10½— 11½	10 — 11	10⅞	10⅜

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless therwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Oct. 21st.	Closing Quotation Oct. 28th.	Business done during week ended Oct. 28th, 1896. Highest.	Lowest
80,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	£	5 % §	2½%	...	⅞— 1⅛	⅞— 1⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	£	6 % §	3 %	...	1⅛ — 1⅜	1 — 1¼	1¼	1 1/16
125,000	Do. do. 4½ % Perp. Deb Stock.... ...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	97 — 101	97 —101	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10½	10
207,649	Do. do. do. £4 paid	10	...	...	...	4½— 4⅝	4 — 4¼	4	...
830,000	City and South London Railway	Stock	1⅛%	1⅛%	1 3/16%	50 — 52	50 — 52	51½	51
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	*nil*	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1⅝— 2¼	1⅝— 2¼	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	5 %	1½— 1⅝	1½— 1⅝	1 9/16	1½
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅛— ⅜	⅛— ⅜	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	¼— ½	¼— ½	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ..	10	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17½— 18½	17½— 18½	17¾	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	110 —115	110 —115	...	...
53,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	21½ — 22½	21 — 22	21⅝	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108xd	105	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅜%	13 7/16— 13 9/16	13 7/16— 13 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅞— 17⅛	16⅞— 17⅛	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	39 — 42	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	106½	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000. £6 paid ...	10	...	...	...	7¾ — 8¼	7¾ — 8¼	8⅛	7⅞

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7, £5 (fully paid), 9⅝.
Electric Construction Corporation, 6 % Debentures, 103—106.
House-to-House Company (£5 paid), 4⅛—4⅜.
Do. do. 7 % Preference, of £5, 8⅝—8¾.
Do. do. 4½% Debentures of £100, 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10¼—10⅜; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8¼.
London Electric Supply Corporation, £5 Ordinary, 1 5/16—1 1/16.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7⅞—8¼.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

APPLIED ELECTRO-CHEMISTRY.

By JAMES SWINBURNE.

Cantor Lecture III.—Delivered before the Society of Arts, May 11th, 1896.

Removing Tin from Scrap.

As sheet tin has from 3 to 5 per cent. of pure tin, it is clear that if all the scrap could be collected and have its tin taken off, the process would be very valuable. Tin is a very expensive metal—worth, say, £80 a ton. If scrap tin is worth £1 a ton, £100 worth would contain £240 worth of tin, and the iron or steel would be worth considerably over £100. The presence of tin makes scrap tin useless as iron, but if it is completely removed, the scrap can be worked up into good quality iron. My attention was specially attracted to tin by an inventor who came to me with a patent for stripping it. As the patent he owned seemed useless, I worked out another process. This was not electric, and consisted in dipping the scrap in baskets into fused caustic. If old tins were used this also melted out the solder, and corroded labels and varnishes so as to get at and remove the tin under them. The resulting stannate of soda was to be sold in that state, as it is a marketable chemical. The scrap coming out of the fused caustic had a good deal of the caustic sticking to it. It would on a large scale, therefore, be washed in successive baths, getting weaker and weaker, and ending in water; the liquid being gradually moved up into the fused vat to replace that removed as stannate. By this means the expense of evaporating down all the caustic that adhered to the tin could be kept down. This process works fairly well, but it is difficult to get the caustic to take up enough tin. The stannate thickens it very quickly, and the resulting mixture never contained enough stannate to be a commercial article. The tin could be easily removed from the caustic by electrolysis and came down well.

This process seemed fairly promising, but at this stage it was found it had been tried before. A company had been formed to work it. Whether that company is now flourishing or not I do not know. As a matter of fact, the process is probably quite old, as it is fairly obvious, and the skinning of scrap tin has exercised a great fascination for inventors for years.

As it was of no use going on with an old process another method was sought. Acid electrolytes attack the iron as well as the tin, and were therefore out of the question. Curiously enough, if sheet tin is used as anode in caustic soda solution, the tin does not go into solution; oxygen comes off. I had tried a number of experiments in 1882, with sheet tin as backing for peroxide plates in alkaline solutions, for secondary batteries. If sheet tin is boiled in caustic lye the tin is not attacked. If clean iron is dropped in, bubbles of hydrogen come off the iron, and tin goes into solution. Strangely enough, however, this process does not act, because very soon the clean iron gets coated with tin, and the action stops. It is very odd that tin should be eaten off one piece of iron and then deposited from the solution on to another piece. This gave the key to the electrolytic process. All that is needed is to heat the caustic bath. The anode no longer gives off oxygen, and the tin is stripped off perfectly and deposited nicely on the cathode.

This process seemed perfectly successful; the next thing was to try it commercially. There are supposed to be thousands of tons of scrap tin wasted every year. It is said to be largely used for mending roads. When we tried to get it, none was forthcoming; and it seems as if the whole idea of there being an important industry in the recovery of tin from scrap is erroneous; the difficulty is to get the scrap. Makers of large tin goods sell their clippings to people who do smaller work, and, finally, the scrap is distributed in such a way that it cannot be collected profitably. The recovery of tin and lead from old cans might be carried on on a very small scale by corporations, but it is questionable if it would pay, owing to the quantities available. This is an illustration of the principle that the great difficulty of the inventor is to discover a long-felt want.

Aluminium.

It would be of little use, even if there were room for it, to write a long description of the manufacture of aluminium by the various electrical processes, as full accounts of the works at Niagara, and to some extent of the Swiss and French, as well as the English works, have frequently gone the round of the technical journals.

It is very difficult to know what place aluminium will ultimately take in commerce. It is first to be a marvellously strong, light and cheap metal, practically indestructible, and combining all the good points of all other metals; then it is run down as being soft, treacherous, easily corroded, and only useful in a few overrated alloys. The truth of course lies between these extremes. It is now becoming more generally realised that aluminium has really a very great affinity for oxygen, even at ordinary temperatures. The only reason why it does not combine with the oxygen of the air quickly enough to catch fire seems to be that the coating of oxide formed is very adherent and hard, and protects the metal. At the same time it is exceedingly thin, and so transparent that the metal shows a beautiful polish, though the surface is really covered with a crust of alumina. The presence of this thin crust is shown by the difficulty of getting solder to take on to it. The coating of alumina also makes it difficult to make electrical contact with aluminium unless enough force is used to abrade the metal and expose a new surface. I have utilised this property in connection with the telephone used as a galvanometer in a Wheatstone bridge or potentiometer. The telephone circuit is made and broken by scraping a wire over a piece of sheet aluminium. This is far more easily heard than the scraping of

a wire over the teeth of a file, or anything of that sort. No doubt the copper wire only occasionally breaks through the coating of alumina, and makes a short contact which is soon absolutely broken by the coating of insulating alumina again. If mercury is placed on aluminium, and the aluminium scraped so as to expose a clean surface to the mercury, the mercury amalgamates it. The amalgam, however, cannot protect itself by an adherent coating of alumina, and the oxide forms in light growths of fluffy alumina. If a drop of fairly strong amalgam of alumina is left exposed to the air, the oxide will grow from the surface of the mercury into a thing like the "Pharoah's Serpent," which children make by burning sulpho-cyanate of mercury, when their parents are foolish enough to let them. Caustic alkali, or any acid that dissolves the alumina, will corrode aluminium. Another old experiment which shows the coating of oxide is due to Farmer, who fused a piece of aluminium wire by means of an electric current, and found it kept its form as a perfectly flexible and mobile conductor, which could be deflected by a magnet, and so on. On pricking the wire with a needle the melted aluminium ran out from the inside. This experiment shows that even melted aluminium, which appears beautifully bright and remains clear like silver, is really protected by a surface film of alumina.

The action of dilute acids, such as nitric and sulphuric, is very curious. Though aluminium does not deposit from the nitrate or sulphate in an electrolytic cell, hydrogen coming off instead, it is not at all quickly dissolved in dilute acid. I tried to make use of this property in an electrolytic meter for alternating currents. Two plates were to be employed in dilute acid, the aluminium going into solution at the anode during each half period, without being deposited at the cathode. No sample of aluminium that I could obtain was acted upon little enough by the acid when there was no current, for such a meter to be accurate within commercial requirements.

Commercial aluminium loses greatly by being impure. Very slight traces of impurity spoil the metal. Commercial aluminium contains traces of silicon, sodium, carbon, and of other metals such as iron. A ½ per cent. or so of sodium is quite a common impurity, and may do great harm. It may not be diffused equally throughout the mass, but may be segregated. This not only makes the metal non-homogeneous, and provides veins or flaws of weak metal, but on passing from sodium to aluminium every grade of alloy from nearly pure aluminium to nearly pure sodium is traversed, and some of these alloys are certain to be brittle. Sodium must also have a great tendency to cause corrosion. Not only does sodium oxidise in air and decompose water, but the hydrate formed itself, dissolves alumina, and attacks aluminium, forming sodium aluminate.

It is questionable if the contamination by sodium can be avoided in the electrolytic processes. There must be sodium present in the electrolyte, and the amount that goes into the metal must be rather a matter of current density and of the strength of the electrolyte in aluminium. Such impurities as carbon and silicon give trouble, not only because they alter the character of the metal, but because they are strongly electro-negative to aluminium; and when they are exposed in small particles they form little local couples, and give off hydrogen, thus allowing the neighbouring surface to be oxidised. It would probably make a very great difference in the value of aluminium if it could be purified further. Ninety-nine per cent. aluminium is already a commercial product, but it would be worth much more if it were 99·9 or 99·99 per cent. of aluminium. There is a great opening for a cheap and efficacious method of refining this metal further. There are rumours of such a process recently brought out or set to work in Paris, but no particulars are to hand yet.

One of the great difficulties in the commercial use of aluminium and many of its alloys is that of soldering. The problem of soldering aluminium is like that of making motors for ordinary alternating currents: it is solved with a flourish of trumpets every week or two, but somehow commercial aluminium articles are found to be carefully designed not to need solder. One of the difficulties is to get a clean surface of metal exposed to the solder. The principle underlying the use of such fluxes as zinc chloride, rosin, or borax, is that they dissolve the oxide of the metal to be soldered, and of the solder, leaving two clean surfaces to run together. Now, there are few chemicals which will dissolve alumina which will not also vigorously attack the surface of aluminium. There are, however, a few substances available, but some of them need such a high temperature to enable them to dissolve the alumina that the metal is softened. This prevents such fluxes being used for rolled or stamped aluminium work, as once it is softened the metal loses much of its value. A soldered vessel, for instance, cannot be re-rolled to harden the metal again. One method of getting the solder to stick is to scratch the aluminium under the surface of the solder. There are also several kinds of solder in the market which take on aluminium. This is not enough, however. To make soldering efficient it should not only adhere where carefully rubbed on, but should run easily and quickly into joints and crevices, as in sheet-tin, lead, or brass work.

Once the solder has been got to adhere the joint may be quite useless. It is quite easy, for instance, to solder two pieces of aluminium together, so that they will tear through the metal rather than through the solder. Similarly, a screw head may be soldered to sheet aluminium, and when torn off it will take a disc of aluminium with it rather than break the joints. Make these joints and examine them after a few months, or even weeks, and it will be a very different matter. The solder appears to separate completely from the aluminium, or at any rate it comes off with the slightest force. I believe this does not happen with all samples. It may be due to sodium in the metal, or it may be due to an alloy between the solder and the metal being able to decompose water and thus being corroded. It is possible, for instance, a trace of sodium may help an alloy of aluminium and tin to decompose water. It is a curious thing that a failed soldered joint frequently has the same smell as iron has when acted on by dilute acid. This is generally said to be due to minute traces of hydrocarbon formed from the carbon in the iron, and there is very much less carbon in aluminium. The smell seems to be good evidence of the decomposition of water at the soldered joint. A soldered joint will also sometimes evolve gas very slowly if left in water for some time.

There is another possible explanation which may be brought forward. The two explanations are not antagonistic, and the effects may work together. Aluminium alloys are generally very brittle, or even powdery, if they have a large proportion of aluminium and of the other metal. Thus aluminium with a little copper is a good alloy, and so is copper with a little aluminium, but an alloy of about equal parts is very brittle. Some of the alloys containing large proportions of aluminium and another metal tumble to powder spontaneously in a few weeks. If a metal or alloy is used as a solder, which forms with aluminium in any proportion a brittle or unstable alloy, the probability is the joint will go; for if you pass from the solder to the aluminium you must pass through strata of solder containing more and more aluminium until you are in pure aluminium: and therefore you must pass through a stratum of unstable alloy. This stratum must completely separate the solder from the aluminium; and if it is brittle, or if it spontaneously falls to powder in course of time, the joint must be bad. The obvious cure here is to use a solder that already contains more aluminium than the unstable alloys. Various solders of this sort are in the market.

As regards the uses of aluminium and its alloys, enough has been written in the various technical journals. As already suggested, the pure rolled or drawn metal may come into much more extended use when it is supplied free from impurities, such as sodium and silicon. There are other uses than mechanical to which aluminium may be largely applied in the near future. Its great affinity for oxygen, which is its worst characteristic in mechanical work, is its merit in chemical and metallurgical applications. A little aluminium greatly improves many cast metals. It may be that the metals contain dissolved oxide. Copper, for instance, is apt to contain dissolved oxide, which deteriorates it, and is stirred with a green pole before running off. [It was a Cambridge undergraduate who asked his coach if a blue pole would do as well.] It is quite possible that such traces of oxide are reduced at once by aluminium, and that the alumina is insoluble in the molten metal, and rises out at once.

Aluminium can also be used to replace other metals, as it has a very strong affinity for oxygen, sulphur, and chlorine. Thus Vautin makes chronium by heating aluminium with a salt of that metal. Aluminium heated with sulphide of iron yields pure iron with no trace of carbon, a substance that is not familiar to many. As, in such cases, the products are not easily volatile, and as the action disengages a great deal of heat, enormous temperatures may be obtained in this way. In this way almost any mutal may be obtained, as few have such avidity for oxygen, chlorine, or sulphur.

The amalgam of aluminium, or amalgamated aluminium, can also be used as a reducing agent in organic chemistry. It decomposes water rapidly, and reduces many organic compounds. It was generally thought that water must be present for the reduction to take place. This is probably the remains of the nascent hydrogen notion of reduction. People saw bubbles of hydrogen come off zinc in dilute acid, and they found reduction of reducible salts took place, so they jumped to the conclusion that the reduction was the result of the nascent gas, not merely another effect of the same cause. Wislicenus and Kaufmann have finally shown that the amalgam works without water; absolute alcohol, previously freed from all traces of water by amalgamated aluminium, being used as the solvent. It is a question of price how far aluminium may come in in the organic colour industry.

There is a difficulty about electro-plating aluminium. It seems as if it might be possible by using a very high-current density, just as sodium can be deposited from caustic. It may also be possible to deposit an aluminium alloy from an aqueous solution, as alumina has great affinity for some metals, incandescing on alloying, just as sodium does when dropped into mercury. Various accounts of processes of plating aluminium from aqueous solutions have appeared, but I, for one, have never seen a decent sample of the results. It is, by another process, quite easy to coat iron or copper with either aluminium or aluminium bronze, and to produce a thick and impermeable coating which is quite permanent. This coating is rough, however, and has to be filed up and polished; and it is difficult to do this without occasionally getting through the coating down to the metal underneath. Such a coating may be very useful for large objects exposed to rough usage or to the weather, as merely sand papered up or pickled it has a handsome appearance.

The further cheapening of aluminium seems to depend on perfection of detail in manufacture which will be caused by keen competition. Cheaper methods, or, rather, cheapened methods, of producing pure alumina will gradually be introduced. There has been a good deal of talk recently about making aluminium from the sulphide; but it is difficult to say how far any sulphide process has been reduced to practice. It might give purer aluminium, and take less power. It might also save expense in anodes, as at present the anodes are burned just as much as if they were used for reducing alumina in a furnace. The use of sodium for replacing aluminium seems quite a thing of the past. There seems much more chance of aluminium being obtained by furnaces without electrical aid. The Cowles furnace really seems to work by temperature alone. The heats of combination do not necessarily settle whether an oxide will be reduced by carbon or not. It may be that the very high temperature is necessarily only to bring the carbon and alumina into contact. Either the alumina may melt, or the carbon may volatilise. A solution of alumina in a haloid salt is not easily reduced by carbon, however.

The Electrolysis of Fused Salt.

The manufacture of sodium and chlorine, or sodium and bleaching powder, from fused salt direct seems so absurdly simple and easy,

that it is a very tempting problem; and if there were not very much more serious difficulties than appear at first sight, such a process as the simple electrolysis of melted salt would very soon oust all others. If a simple method could be devised, sodium could be made at a few pounds per ton. It would be used in very large quantities for the reduction of aluminium, and for replacing iron in the making of cyanides for gold extraction. It would doubtless also be used in innumerable other processes where a cheap and powerful reducing agent could be employed. All this is, however, a small matter; caustic and carbonate would be made from the metal. Instead of a ton of caustic soda, a paper maker would buy 11½ cwt. of sodium, which he would convert into hydrate by treating with water. At present we need hardly trouble ourselves about means of treating sodium with water by the ton. It could, of course, be done. The hydrogen might or might not be utilised, and in some cases it might be worth while to get electrical energy by using the sodium in cells. This is unlikely, however; and we are not yet sufficiently near the economical manufacture of sodium to discuss its uses at length.

The difficulties in the way of the direct electrolysis of salt are enormous.

In the first place it must be fused. If it is heated by a furnace, it must be in a suitable vessel. Most kinds of stoneware and earthenware are attacked by fused salt, and are also likely to crack. Iron is the most promising material, but in time it will probably oxidise and scale away. The cost of thick cast-iron pots, something like those used in finishing caustic, might not be excessive. It might be possible to heat the salt by the current that electrolyses it. With a given fall of potential spent on the resistance of the electrolyte, it is easier to keep a large vat hot than a small one, so this method can only be used economically on a large scale. The containing vessel may then be practically solidified salt.

The anode does not give any serious trouble. Carbon is practically indestructible in fused chloride of sodium, as even hot chlorine has no action on it. If the salt contains any oxygen compounds, such as oxide of sodium, due to combustion of the sodium or sulphate of sodium, a carbon anode will, of course, be attacked and eaten away. The chlorine that comes off must be kept within some sort of hood, and this gives rise to a new difficulty. Red-hot chlorine, if one may use such an expression, is not at all convenient to handle on a large scale. Perfectly dry chloride is said not to attack metals, and sodium will keep a bright surface in contact with dry chlorine. But though the chlorine from red-hot salt must be fairly dry, it attacks metals at once. No metal can be used as anode in fused salt, for instance, and after it has come off the chlorine will attack, say, an iron hood. Then there is also difficulty in making good contact between the conducting lead and the anode, as the lead being metal, cannot be in contact with the hot chlorine, and the carbon, on the other hand must not be exposed to the air. On a large scale, it is probable there will also be some difficulty in cooling large quantities of chlorine, as the chlorine must, of course, not be led into the bleach chambers already hot.

The cathode itself, of course, offers no difficulty. Iron, or, perhaps, copper can be used. Sodium, however, floats on fused salt. The surface round the cathode must therefore be covered in, and the sodium either collected and poured off, or distilled over. To distil sodium needs a fairly high temperature, which, other things being equal, is a drawback. A still greater drawback is that the sodium does not distil clean, but comes over mixed with salt vapour, and the sodium and salt are condensed together, making a mixture which is difficult to treat.

The chief difficulty as regards the cathode is the hood. Such materials as porcelain are attacked by sodium or sodium vapour, so sodium must not come in contact with them. If iron or copper is employed, as soon as there is a layer of sodium on the top of the salt it makes contact between the cathode and the hood, and the further liberation of sodium is on the outside of the hood, where the metal burns. This not only means waste, but the oxide formed dissolves in the fused salt, and finally burns the carbon anodes. Porcelain hoods have been tried. Many kinds of stoneware or fireclay will stand fused salt well enough; but it does not follow that it will stand in an electrolytic vat. Apparently, at the temperature of fused salt it conducts enough to be practically electrolysed. Poincaré gives the conductivity of hot porcelain as about a hundred-thousandth of that of fused salt. It may also be partly attacked by the rather mysterious subchloride of sodium, which is supposed to be produced. Such a compound may reduce silicates, just as sodium does. Borchers has proposed or used chamotte, which is, I believe, stoneware made of old fired stoneware, ground up and mixed with new slip, and again fired. I do not know what success this material secured. Another proposal is to use porcelain hoods both for the anode and cathode, and to prevent any action by keeping them cool by water circulation. The hood is then coated at all vital points with a casing of cold solid salt, which is an insulator, and protects the porcelain from all attacks on the part of the salt, electrolysis, sodium, or sodium subchloride. Still, the close proximity of melted salt, red-hot sodium, chlorine, and cold water, with nothing but porcelain to separate them, must always be discouraging to a workman whose life is not insured. When all the difficulties so far mentioned have been successfully surmounted, there is still another drawback, and that is that probably there will be no sodium. If a small current density is used, no sodium will appear. It was most likely this phenomenon that led the earlier experimenters to suppose that fused electrolytes conducted without decomposition, like metals. What really happens it is very difficult to say. It is generally supposed that the sodium forms a subchloride, but a subchloride of a monad element is a little difficult to believe in. Photographers are on very familiar terms with subhaloids of silver, so we must not be too sceptical about subchlorides of sodium. If the cathode is watched in a cell of fused salt, the liquid appears to be violently disturbed, and luminous red streaks come from the cathode. This looks rather as if sodium was being carried in clouds of small particles into the mass of the salt, and these combined with the salt with evolution of heat. If salt is taken from the neighbourhood of the cathode and cooled, and examined through the microscope, it is found to be full of black specks. On adding water there is effervescence. This looks as if the sodium was not in the form of subchloride, but in little metallic globules. The luminous clouds may be merely clouds of globules of hot sodium, the high temperature being due solely to the enormous current density in the immediate neighbourhood of the cathode. The presence of sodium, or of particles that may be assumed to be sodium, in the cooled salt does not show that they exist at the higher temperature. It is possible that subchloride of sodium exists at the temperature of melted salt, but splits up into normal chloride and sodium on cooling. Lithium if heated in contact with lithium chloride in a closed vessel disappears, apparently forming a subchloride The subchloride of lithium has even been investigated as regards its fluorescent properties. Chloride of sodium acted upon by cathode rays in a vacuum tube gives off chlorine and turns orange or bluish, and subchloride is said to be formed. Lithium chloride is said to be decomposed in the same way.

It is possible that sodium is not actually deposited against or on the electrode, but in the immediate neighbourhood only. If mercury is used as cathode in a strong solution of a lead salt, and a large current density is employed, it will be found that lead trees grow on the surface of the mercury. Mercury amalgamates clean lead at an enormous rate—so fast, that if you agitate the cathode by touching the cell, trees several inches long will disappear into the mercury so quickly, that the eye cannot follow the movement. If the surface of the mercury is watched, it will be seen that the lead is always beginning to form trees; but they are rapidly sucked in by the mercury. It appears as if the lead is not deposited into or really in contact with the mercury, but is thrown down in its immediate neighbourhood, and is then amalgamated by the mercury. If this is the case, it may account for the small yield of sodium from fused salt. It is possible the sodium is deposited in very small globules in the immediate neighbourhood of the cathode, and that a large proportion of it is swept away by the surging salt, and is eventually burnt on the surface of the electrolyte, or turned into salt again at the anode.

The melting point of salt is reduced in practice by adding other chlorides, such as that of calcium, to the bath. Of course only those chlorides can be used which do not deposit metals more readily than salt. It is quite possible that a little calcium is deposited with the sodium; but it is so difficult to make sodium commercially by this method, that an inventor would feel quite encouraged if he obtained any sodium to speak of, even if it were largely contaminated with calcium.

The difficulty as regards the collection of sodium has been overcome by Vautin in a very ingenious way. He uses a cathode of fused lead. According to Borchers, whose works are a veritable mine of information, this idea is old, as Rogers deposited sodium into lead and zinc in 1886—89, and published an account of his successful results. Vautin has gone further than this, however. The lead-sodium alloy is in connection with a second vat, to which steam is admitted. This takes out the sodium, and if the steam supply is properly regulated, pure fused caustic is produced, and has only to be run into drums and sold. This arrangement overcomes a great many of the difficulties inherent in the electrolysis of fused salt. There is no difficulty in collecting the chlorine, as the sodium does not also rise to the top of the vat.

Lead sodium alloy is available for very many of the purposes for which plain sodium is employed. It would probably not pay to use it for getting aluminium, as the electrolysis and substitution would probably cost more than the simple electrolysis of a cryolite and alumina bath. It is available for the production of cyanides from potassium ferro-cyanide. As sodium has a lower combining weight, as well as a lower price than potassium, sodium cyanide is, on the whole, preferable to potassium cyanide; and it is, I believe, just as good in gold extraction. It must be practically entirely ionised in the very weak solutions used in leaching gold ores; so the metal can hardly make any difference. As potassium cyanide is estimated by its cyanide, the metal being assumed, the use of sodium in the reaction with the prussiate of potash gives a cyanide which tests at over 100 per cent. This has astonished not a few analysts, but is pretty generally understood now.

THE CELEBRATION OF THE JUBILEE OF THE ELECTRIC TELEGRAPH.

Speech by M. J. Banneux, Engineer-in-Chief, Director of the Belgian Telegraph Administration, at the Meeting at the Palais des Academies.

Mr. President, Ladies, and Gentlemen,—We are celebrating to-day the jubilee of the establishment of the electric telegraph in Belgium. On the Continent of Europe, our country was the first (September 9th, 1846) to open to all this marvellous mode of transmitting thought, a mode regardless of space and time. In the Old World, England alone was ahead of us.

Having become habituated to the use, under all circumstances of life of the wonderful system which now brings into instantaneous communication all the inhabited parts of the globe, the present generation hardly realises the slowness of intercourse at a time when wind, steam, and horses, were the only means at our disposal for the

transmission of news. Nevertheless, electric telegraphy, as we know it to-day, is the work of this century exclusively: the Voltaic pile dates from the year 1800, and the first instruments of a practical character did not appear until between 1837 and 1844.

The period of the application of electricity to telegraphy is therefore very short; but what progress has been realised by it! What benefits have resulted from it! What evils have been prevented or overcome! What immense service has been rendered to industry, civilisation, and universal intercourse! A frail metallic wire branching out in every direction encircles the terrestrial globe; it passes through the air in all latitudes and through the depths of the seas; the current travels at a speed far beyond the perception of our senses, 300,000 kilometres per second, marking its presence, at the end of its career by mechanical work which is translated by man into the vocabularies of thought. Before this manifestation of a mysterious force brought by them into subjection for the benefit of humanity, those whose genius and perseverance achieved for us this fresh conquest, uttered a cry of admiration and gratitude: "*What hath God wrought?*" Such were the words of the first dispatch sent, May 24th, 1844, along Prof. Morse's line between Washington and Baltimore, and the first trans-Atlantic cable, on August 16th, 1858, flashed from the Old World to the New the biblical hosanna: "Glory to God in the highest, and on earth peace, goodwill toward men."

Electric telegraphy can reckon with pride among its votaries a long series of savants, inventors, intrepid pioneers, conquerors, but—an exceptional triumph—no victims. In its infancy, however, it did not escape indifference, ridicule, and even hostility, a fate attending all applications of science, extraordinary either in their principles or their methods, and fruitful in beneficial results on the morals, intercourse, and prosperity of nations.

Now that 4,700,000 kilometres of conducting wires intersect the continents and seas, it is only fair to go back to the early days of telegraphy and recall the names of the men connected with them, in order that they may once more be honoured in the memory and hearts of Belgian telegraphists.

We will first say a few words with regard to Claude Chappé's semaphore, referred to by Nadaud in the following lines:

"Que fais-tu, mon vieux télégraphe,
Au sommet de ton vieux clocher?"

The first line used for overhead telegraphy, established in 1794 from Paris to Lille, did not give place to electricity until 1849. In 1803 it was extended to Brussels, and in 1809 to Antwerp and Amsterdam. According to a note, for which we are indebted to Mr. Wauters, the learned keeper of the records at Brussels, Chappé placed on the two towers of Sainte-Gudule semaphore telegraphs; one communicated with Lille and Paris through the stations of Dilbeck, Pamele, Sint-Auteliux, Oudenhove, Saint-Corneille, Nieuwkerke, Saint-Genois, and Roubaix; the other communicated with Antwerp through the stations of Vilvorde, Mechlin, and Waterloo. These lines disappeared during the political turmoil of 1814.

The French system numbered, in 1844, 534 stations, extended over 5,000 kilometres, and connected 30 towns. When not obscured by darkness, snow, fog or rain, a signal was repeated from station to station in 15 seconds; it thus passed from Brussels to Paris in about 6½ minutes. The State could thus transmit each year on an average 6,750 dispatches, occupying about two hours, through 50 stations; a dispatch cost altogether 151 fr. 75 c. This system was not open to the public.

All this time electrical science was being enriched by discoveries and inventions. Dr. Samuel Thomas Sœmmering, in 1809, invented a telegraphic apparatus based on the decomposition of water by the voltaic current, and employing a wire for each figure or letter. This apparatus was seen at work at Munich, on August 22nd, 1811, by Prince Leopold of Saxe-Coburg, afterwards our first king. In 1816 the Englishman, Francis Ronalds, used frictional electricity for producing, by means of a single conductor, the simultaneous divergence of balls of elder-pith in front of two dials rotating synchronically. He invited Lord Melville, First Lord of the Admiralty, to witness his experiments, and received this memorable reply:—"Mr. Barrow begs to inform Mr. Ronalds that telegraphs of any kind are quite useless, and that no other than the one in use will be adopted." The one in use was an overhead system of the Chappé type! In 1819 and 1820 came the fundamental discoveries of Oersted, Ampère, Schweigger, and Arago; Ampère proposed a system in which the deviation of magnetised needles equal in number to conducting wires corresponding to the letters of the alphabet, was used to transmit messages. In 1827 the mathematician Ohm published his famous formula; in 1831 Faraday discovered the phenomena of induction. Two years afterwards, Gauss and Weber tried their galvanometric mirror telegraph; in 1837-1838 Steinheil substituted for the earth a return wire, and put in action his telegraph with galvanometric magnetised bars, writing in two lines the signs of an alphabetical code. We are now coming to the time when telegraphy passed out of the purely experimental period.

Ampère's idea was taken up by the Russian Baron Schilling, who, in 1832-1833, used 72 wires and 36 horizontal magnetised needles, inserted in multipliers, in order to obtain, by the reversal of the voltaic current deviations to the right or left, and thus to design letters and figures. This telegraph was reduced later on to five needles, and even to one single needle, and excited a great deal of curiosity. In March, 1836, William Fothergill Cooke saw it at Heidelberg in the course of Prof. Muncke's lectures, and it made so great an impression on him, that he abandoned that very day his occupation of preparing wax anatomical models in order to devote himself entirely to telegraphy. Cooke was 30 years old; he knew nothing of electricity, but he could foresee the advantages to be derived from this new mode of communication, and he set to work at once with admirable ardour, allowing himself neither relaxation nor rest until he had devised and realised mechanism capable of improving Schilling's telegraph, and rendering it practical. At the end of two months, he had arranged a telegraph with three horizontal galvanometrical needles, each worked by two wires, with an alphabet of 26 signals, an alarm or bell worked by electro-magnets or clockwork, and a mechanical telegraph on the principle of a musical box. In July, he had constructed an apparatus with escapement, in which a pendulum, moved by electro-magnetic action, caused the rotation of an index on a dial. The instrument required only a single wire, and gave 60 signals. The directors of the Liverpool and Manchester Railway found it too complicated for their purposes, and, moreover, railway companies were not yet prepared to experiment upon what one writer calls the vision of a dream. Cooke's faith was in no wise damped by this check, but he felt his scientific incompetency: so many problems remained to be solved before success could be attained. On February 27th, 1837, the young man had the good fortune to join Charles Wheatstone, Professor of King's College, London, whose fame dated from the day when, by a splendid experiment, he measured the speed of propagation of electricity. Wheatstone, with a purely scientific object, had on his own account designed a telegraph with horizontal galvanometrical needles. The association of these two men, which was sealed in May, 1837, was to produce the most brilliant results; it is to their co-operation that we owe the introduction of the electric telegraph.

The first practical trial of the system that combined the inventions of Cooke and Wheatstone took place July 25th, 1837, over a distance of 2 kilometres, between the stations of Euston Square and Camden Town, in the presence of Robert Stephenson and Brunel. The receiving instruments consisted of five galvanometers with vertical needles oscillating in front of a frame, and representing by their convergence letters and figures; each galvanometer was placed in the circuit of two copper wires, covered with cotton and boiled in pitch, laid underground in the grooves of triangular pieces of wood, also coated with pitch. The English call this line the "fossil" telegraph.

The success of this attempt induced the railway companies to negociate with Cooke and Wheatstone for the establishment of the telegraph along railways; as a rule, with a single line. Cooke redoubled his efforts. "With his own eye and his own hand," said a contemporary electrician, "he directed all operations; he literally lived on the railways, making a carriage his sanctum during the day, and sleeping in one at night." The five needles of the first telegraph were reduced to four in 1838, to two in 1842, and, finally, to one in 1846. The system was complete, and satisfied all the requirements of correspondence; but the public did not realise the advantages it offered: "a few understood it, many admired it, but the majority remained incredulous." The companies authorised their employés to transmit gratuitously private messages at times when the railway service left the conducting wires inactive; notices were published in the newspapers, and the telegraph offices were opened to those provided with a pass. In 1845, the little line from Paddington to Slough, on the Great Western Railway, figured amongst the marvels of London. On January 1st of that year, public attention was drawn to the telegraph by the prompt arrest in London of a murderer, apprehended as he got out of the train, owing to a message sent from Slough. Circulars were distributed in the streets, of which the following is a specimen:—

"THE WONDER OF THE AGE.

"Instantaneous Communication.

"Under the special patronage of Her Majesty and His Royal Highness Prince Albert.

"Galvanic and electro-magnetic telegraphs on the great Western Railway may be seen at work every day (Sundays excepted) from 9 a.m. to 8 p.m., at the Paddington telegraph office, and at the telegraph cottage at Slough.

"This exhibition is acknowledged by its numerous visitors as being the most interesting and attractive of all offered by the great metropolis. In the list of visitors we find several of the crowned heads of Europe, and almost all the English nobility.

"Questions suggested by the visitors will be asked by means of the apparatus, and answers will be received from a person 32 kilometres away, who, at every question, will ring a bell and fire a gun in an incredibly short time after the signal has been given.

"Entrance fee, 1 shilling."

In 1846 a message of 20 words from London to Dover cost 6 francs 25 centimes; it was said that the price asked must not be too low, for fear the public should use the telegraph instead of the railway.

The first company formed exclusively for the working of the electric telegraph was started in September, 1845, under the name of the Electric Telegraph Company. It had at its head Cooke and the Ricardo Brothers, and began work on a small scale about July, 1846. By June, 1848, nearly all the capital was lost; the public only used the telegraph under very special circumstances. Not till 1850 did the enterprise become remunerative, and competition begin. From 1850 to 1861 several important companies were formed, using Henley's magnetic apparatus with needles, Bain's electro-chemical apparatus, Bright's acoustic signal apparatus, and lastly, Hughes's type printing apparatus, until the introduction of the apparatus invented by the American, Samuel Finley Breese Morse. And when in 1870 the English Post Office bought up all the private telegraphs of the United Kingdom, the price paid for them was 200,000,000 francs.

The history of the beginning of practical telegraphy in the United States runs on the same lines; we might say that we have only to change a few names and dates. Morse, like Cooke, was no savant well versed in physical science; his skill as a painter scarcely gained him a living; but like his English rival, he had faith, energy and perseverance, and like him, although after greater struggles, he finally attained success. Cooke was supported by Wheatstone; Morse received the assistance of Alfred Vail, and of Profs. Gale and Joseph

Henry. In the United States, as in England, the innovators had to fight against indifference and incredulity; nevertheless the Old World seems to have had a quicker perception of the benefits that would be conferred by the telegraph, and did not go so far as to tax with madness the grand projects of the inventors.

After five years of study and work, on September 2nd, 1837, Morse worked in public, at the University of New York, where he taught the history of the Fine Arts, an apparatus which, under the action of an electro-magnet, traced on a strip of paper in motion inclined lines forming angles, the summits of which represented different figures. A dictionary enabled these figures to be translated into words and phases. The transmitter was automatic, and consisted of type arranged in a kind of printing frame. Morse presented his system to the Government, and asked for $30,000 in order to try it over a distance of 80 kilometres.

He took his instruments to the Capitol at Washington, and demonstrated their capabilities before members of the Congress, the city authorities, and numerous visitors. He used all his means of persuasion: "This mode of communication was undoubtedly destined to become the instrument of an immense power for good or ill, according as it should be well or ill directed; the government should take the telegraph exclusively under its own control; and in a little while, the inhabitants of the United States placed in instantaneous communication would really become neighbours." This was too good to be believed; people's minds were not prepared for it. Few Congressmen took the predictions of the new apostle seriously. Communicating at a distance of hundreds of miles, what madness! Really, Morse's solicitations became importunate; the poor man, they said, was nothing but a handle with an electro-magnet in his brain.

The president of the Committee of Commerce in the Chamber of Representatives, Francis O. Smith, issued a favourable report on April 6th, 1838: "Citizens," he wrote, "will acquire an attribute of ubiquity to such a degree that the mind, restrained by an instinctive feeling of religious respect before a power of such terrible magnitude, has hardly dared to regard it seriously as belonging to humanity." The vote gained a majority of one, and the member who turned the scale, when he offered himself for re-election, shortly after was rejected by his electors because he had foolishly wasted the people's money.

Neglected by the Congress, deprived of the benefit of any European patent, Morse nevertheless resumed his work with courage; he modified and improved his instruments, and then began anew his former proceedings, his solicitations, and his experimental demonstrations, until that night of suspense of March 3rd, 1843, when he wrote to his assistant, Alfred Vail: "If the Bill is rejected, I shall return to New York without a dollar in my pocket." The Bill granting him 150,000 francs for the construction of a trial line was passed by 90 votes against 82 at the last hour of the sitting of Congress. Certain members proposed to apply part of the credit either to the encouragement of mesmerism or to the establishment of a telegraph to the moon.

Pessimism and hostility, however, did not overwhelm him. While Morse and his colleagues were preparing to construct the trial line from Washington to Baltimore in the winter of 1843-4, the assistant of the Postmaster-General, the Hon. John A. Bryan, was bewailing himself to a member of the Congress in these words: "There is an abominable plot to ruin me. Would you believe that my chiefs have associated me with Morse's mad schemes, by entrusting me with the control of the $30,000 voted!" The feeling of the authorities, like that of the public, was that the project of a telegraphic transmission at a distance of 64 kilometres was the product of a diseased imagination, and not one amongst them wished to risk discredit or ridicule by being concerned in such a foolish enterprise.

Notwithstanding all obstacles, the line worked, on May 24th, 1844, with the lever key that has become familiar to us, and an electro-magnet of 80 kilogrammes, in which the lever of the armature which terminated in a metallic point, marked dots and dashes on a slip of paper. At last the electro-magnetic telegraph was armed for the conquest of the world! At last, after a struggle of 12 years the poor painter, the follower of a chimera, saw himself on the road to fame and fortune.

The line from Washington to Baltimore for more than a year rendered gratuitously much service to the Government, the railway company, and to private individuals. It was opened to the public on April 1st, 1845, under official control, at the rate of 1½ centimes per letter, and it brought in 15 francs 50 centimes the first week. The Government refused to take over the invention for 500,000 francs, but Smith, Amos Kendall, James Reid, Ezra Cornell, enterprising and enlightened men, could foresee the brilliant future reserved for the telegraph, and warmly received the inventor's proposals. After two years' labour, in 1848, the first telegraph company yielded 6 per cent. to its shareholders, and in 1849, 64 companies in North America were using the Morse apparatus with 293 offices. Need we mention that the Western Union Telegraph Company, formed in 1863, with the motto "*in unitate vis*," by the amalgamation of all similar enterprises, possesses at the present day 1,300,000 kilometres of conducting wires, 21,200 offices, and a capital of 109,000,000 francs.

It would be interesting to search in the history of electro-telegraphy in France for proofs of the passionate hostility encountered from renowned savants and members of the legislative assemblies on the substitution, in 1844-6, of the electric telegraph for the system of the brothers Chappe. In this case the question was complicated by political considerations; it concerned, it was said, the very existence of the Government. After recalling to your memory the name of Louis Breguet, allow me, in order not to trespass too much on your attention, to pass immediately to Belgium. When, in August, 1845, Cooke and Wheatstone asked for permission to establish, for the use of the public, electric telegraphs on some or all of the State railways, the practical value of their system admitted of no doubt. Quetelet, at the risk of being thought to be suffering from mental disease, had, on several occasions, earnestly called the attention of our academy of sciences to Wheatstone's inventions. He had witnessed, at the Royal Observatory of Brussels, experiments made by the learned professor of the Royal College, and expressed a very favourable opinion of the new invention. By decreeing December 23rd, 1845, the concession of a telegraph line between Brussels and Antwerp, as a trial line, the Government put an end to a situation which at any rate since the time of our political emancipation, had given rise to much dissatisfaction on the part of bankers and exchange agents, and the frequenters of the Bourses of Antwerp and Brussels. There were in fact in existence, and particularly between these two cities, private telegraphs in imitation of the Chappé system, the transmissions by which of the quotations from the Paris Bourse, from the capital to the commercial metropolis, far outstripped the couriers, and even later on the railways; hence there resulted for the fortunate proprietors and speculators in public funds and merchandise, considerable daily profits. A royal decree of August 17th, 1834, appointed a committee for the purpose of discussing whether there was any reason to forbid the establishment of private overhead telegraphs, and whether it would be expedient for the State to establish one on its own account. The committee decided both points in the affirmative in the name of the morality of commercial transactions. It authorised the establishment of a section from Antwerp to Brussels, and Lille to be connected with Chappé's line to the French capital. This line was estimated to cost 56,000 francs, and to absorb 45,800 francs a year for working expenses, in order to transmit almost exclusively to Brussels and Antwerp the quotations of the Paris Bourse. The proposal was rejected. In September, 1840, besieged by fresh solicitations, the Minister of the Interior submitted the question of overhead telegraphs to a special inquiry, and consulted the Chambers of Commerce of Brussels, Antwerp, Ghent, and Ostend. The three first could only see in the telegraph an encouragement for speculators in public money and for Stock Exchange gambling. Ghent added: "Commerce has no need of it; the restricted limits of the country, and the increased facilities offered by the railways, moreover, render its establishment useless."

The idea of a Government line between Antwerp and Paris met with the approval of the Chambers of Ostend and Antwerp, as it would give the traffic in public funds a more normal character by the diminution of stock-jobbing; Antwerp, moreover, gravely considered the means of preventing all connivance between speculators and the telegraph operators. Finally, Brussels declared categorically:—"As Stock Exchange transactions are not carried on generally until after the arrival of the courier, the line proposed would entail useless expenditure." Thus advised, the Ministry considered that neither commerce nor public order would be advanced by a change of system, and the private telegraphs continued their operations. In 1842 and 1843, fresh complaints were made. The Antwerp Chamber of Commerce demanded the organisation of a special service, consisting of a locomotive and a mail carriage, for the purpose of transporting express from Brussels to Antwerp, immediately after the arrival of the Paris mail, the correspondence arriving from France. On the other hand, important firms in Brussels applied first to the Government and then to the Chambers of Commerce for the suppression of private telegraphs; they urged the integrity of business relations, the injury caused to Stock Exchange transactions, the interests of public order, and, lastly, the losses incurred by the postal service. Once again a committee was appointed, but the result of its deliberations is unknown to us; the remedy was to be supplied by Cooke and Wheatstone.

Why, after four years' working, did not the English company seek to extend its operations to other lines besides that of Brussels-Mechlin-Antwerp? As a matter of fact, the financial results were anything but encouraging. From March 4th to December 31st, 1849, a period of 43 weeks, 4,221 despatches had been sent, almost all relating to Bourse matters, *i.e.*, there was a weekly average of 98 telegrams, the receipts amounting to 201 francs. After paying 4,056 francs to the clerks, 2,000 francs to the superintendent, John Gibbs, and 2,481 francs for porterage, the service in 1849 showed a balance of 1,341 francs, a sum insufficient to do any good.

However, the line from Paris to Lille, which was sanctioned in 1846, with an extension to the Belgian frontier, was in course of construction, and the Belgian Government had to consider connecting it with Brussels. The English company, being approached in 1847, only consented to co-operate on conditions that were considered unacceptable. An estimate drawn up by M. Masui, railway director, placed the cost of the line at 132,000 francs, a sum too heavy for the public purse; the proposal was adjourned. In 1848 the situation became more pressing; Prussia (and here we must pay a tribute to the name of Werner Siemens) was laying the foundation of its vast system of subterranean conduits, one of which terminated at Aix-la-Chapelle; again our Minister of Finance pleaded the poverty of the times. The following year urgent solicitations from the south and east induced the Government to seek a solution in the public adjudication of the construction and working of some main lines of electric telegraphy; but the project, strongly condemned by M. Masui, was soon abandoned. Everywhere else telegraphy was extending, and Belgium remained alone at a standstill; at any price she must go with the times. On October 13th, 1849, the Minister of Public Works, M. H. Rolin, formulated this programme: "Government to undertake the construction and working; this system of communication to be placed at the disposal of the public according to a certain tariff, and certain regulations to be drawn up; the administration to co-operate with the railways and postal services; a special sum to be allowed in the budget for the ensuing service; 500,000 francs at the most should suffice. My mind is made up on all points. No concessions for the present; to acquire all possible information; not a day to be lost; the subject to be constantly under consideration; not a moment's delay. Forward, march!"

And they marched. Quetelet, Devaux and Cabry being appointed as a committee for the study of the question on December 31st, 1849, gave in their report on March 21st, 1850; on the 22nd the minister presented to the Chambers a Bill which was passed without amendments, and became law on June 6th, 1850; on September 1st the State entered into possession of the line from Brussels to Antwerp, which was given up by Cooke, John Lewis Ricardo and Samson Ricardo for the sum of 60,000 francs, and at the end of the same year a telegraph line, with two overhead wires, was established from Ostend to Verviers, over a length of 241 kilometres.

The year 1851 saw the opening (on March 15th) of the first eight public offices, and their connection with the lines of the Austro-Germanic Telegraph Union; their connection with France through Quiévrain (April 20th), with Wurtemberg (November 24th), with Great Britain (December 5th), by means of the French lines and the submarine cable from Dover to Calais, with which are associated the names of the brothers Brett and the engineer Crampton. In 1852 we entered into communication with the duchies of Modena, Parma and Tuscany, the kingdoms of Hanover and the Netherlands. In 1853 we corresponded with Switzerland and Sardinia, and on June 20th their Royal Highnesses the Duke of Brabant and the Count of Flanders inaugurated, at the Brussels office, direct communication with London by the six-wire cable from Middelkerke to Dover, which was conceded to the Submarine Telegraph Company. All the States of Europe thus entered successively into telegraphic communication. Thus, in 1866, we arrive at the crowning of this gigantic enterprise, and of the long struggle of human resolution and science against the formidable obstacles placed in their path by nature; by the exertions of the great Cyrus Field and a body of famous electricians, the two worlds are united across the ocean by a cable of 3,900 kilometres. Honour to these men, gentlemen; honour to all these *savants*, engineers, and to all the pioneers of telegraphy, without distinction of nationality, who have contributed to the raising of this monument on which is inscribed, "Progress, Peace, and Fraternity."

In the expression of her gratitude, Belgium, is proud to include the names of some of her children who, with various degrees of merit, have a right to claim a share in the establishment and organisation of our telegraph service, Quetelet, Cabry, Devaux and Gloesener as *savants*, Lippens as an inventor and constructor, John Gibbs, the first head of the service, and, above all, Julien Vinchent, the distinguished engineer, the eminent director, the star of the international conferences, one of the founders of the universal Telegraph Union, the worker whose work embraces a period of more than 35 years. He also could say, "*Exegi monumentum*." We will honour his memory as that of a man who has deserved the gratitude of his country and the telegraphic world.—*L'Industrie.*

AUSTRALIAN ELECTRICAL NEWS.

[FROM OUR SPECIAL CORRESPONDENT AT SYDNEY.]

There being so many individuals and companies desirous of connecting Sydney with North Sydney either by bridge and electric tramway, or tunnel and electric railway, the Government have decided to refer the whole question to a select committee with a view of obtainiug a report upon the comparative merits of the various schemes submitted. They decline to commit themselves to any policy, having come to no determination as to whether they would do the work on their own account, or support any of the Bills now on the Parliamentary business papers; in fact they are awaiting further information before making up their minds. The general outside opinion is that a better opportunity may never arise for establishing connection between Sydney and North Sydney than the present one. Money has never been cheaper, material so low, or labour so plentiful. The question before the Government now is practically to decide whether, in their opinion, connection with the two Sydneys is to be undertaken now, or postponed indefinitely. It is a matter of certainty that any private scheme propounded will be most strenuously opposed on both sides of the House, on the ground that the promotion of all such schemes is costly to the general community. Governments have been procrastinating over this question for years past, neither doing the work themselves nor allowing private enterprise to do it; but the matter will have to be decided now.

The Bill authorising the electric tramway in George Street is now practically accomplished, having passed both Houses. The Sydney Municipal Electric Lighting Bill is also in a fair way to completion, having passed all stages in the Lower House and the second reading in the Upper. A Bill has been prepared authorising the New South Wales Railway Commissioners to convert the whole of the steam tramways into electric lines. The only alteration in the existing Act that is required is a slight amendment giving the commissioners power to erect poles in the streets for the purpose of installing and opereating the overhead system. Now that the Bill is through for the George Street line notice will probably be given of this amending measure. Parliament, too, will be asked to vote the necessary funds to permit of the gradual conversion of the whole of the steam lines to the electric system.

Messrs. Crompton & Co. were the successful tenderers for the electric lighting of five of the North Shore Ferry Company's ferry steamers. The plant for each boat is small, consisting of a Chandler high-speed engine direct coupled to Crompton dynamo of 3½ kilowatts output; 6 25-C.P. and 29 16-C.P. incandescents to be fitted in each boat, with possible extensions.

The Feilding (N.Z) electric lighting scheme after considerable flourish has collapsed, as the council is unable legally to borrow sufficient money to carry out the necessary work.

In Tasmania, Devonport is considering the advisability of putting down a central electric lighting station, and the Tasmanian Water Power Electric Company, Limited, a Victorian syndicate, is seeking Parliamentary authority to resuscitate the "Australasian Rights Purchase Act of 1891," giving rights over various water powers in Tasmania, which, now that electricity is flourishing in the island, are being recognised as property of some value.

The Municipal Council of Norseman (W.A.) has granted to a Dr. Harvey the sole rights of supplying electricity for private and public purposes within the municipality for 30 years, Dr. Harvey agreeing to light the streets for the Council free of charge. The Coolgardie and Perth electric light central stations are rapidly approaching the limit of their machinery and considering the question of extensions.

The half-yearly meeting of the A. W. Alcock Electric Light and Motive Power Company (Melbourne), was held on August 31st. The directors' report showed that the profits for the half-year amounted to £2,885 10s. This was regarded as satisfactory, as the result had been obtained without raising the price to consumers during the currency of the late coal strike, which increased the price of coal up to 50 per cent. above the contract price, which in itself was 15 per cent. above that of the previous contract. During the past 12 months the revenue had increased £800, the revenue for the year being £14,680, as against £13,880 for the previous 12 months, while the net profits, after paying for machinery and providing for interest, depreciation, and bad and doubtful debts, were £1,400 better than the previous term.

THE INSTITUTION OF CIVIL ENGINEERS.

The Council has issued a list of subjects upon which original communications are invited. For approved papers the Council has the power to award premiums. The following will interest electrical men:—

7. The Modern Methods of Pumping compared as to cost and efficiency.
10. The Purification of Sewage by precipitation, filtration, electrolytic, bacteriological and chemical processes.
11. The Use of Ash-bin refuse in towns for the production of steam.
12. The Purification of large quantities of Water after its use in Manufactories.
13. The Methods of Enriching Coal-Gas and their effect on its calorific and illuminating values.
14. The Production and Enrichment of Water Gas.
15. The methods of conveying and of using Natural Gas.
16. The Construction and Use of Water-Tube Boilers.
17. The Utilisation of Heat (*a*) generated in the compression of air and other gases; (*b*) carried away by steam-engine condenser-water; and (*c*) contained in boiler-furnace flue-gases.
18. The Methods of Condensing Steam by the use of moderate quantities of water.
19. The Methods of removing Moisture from Steam, and of reducing losses by radiation from steam-pipes.
20. The Production and Use of Super-heated Steam.
21. The Theory and Development of the Compound Steam-Turbine.
22. The Application of Oil and Gas-Engines to tractive purposes on common roads and on tramways, and to the propulsion of vessels.
23. The Design and Construction of large Turbines.
24. The Forms of Turbine most suitable for small Falls.
25. The Methods of Testing the Lubricating Values of Oils, Greases, &c.
27. The Manufacture and Use of Steel for Electro-magnetic Purposes.
32. The Mining of Thin Seams of Coal.
33. The Underground Arrangements in Collieries.
34. The Influence of Coal-dust in contributing to Colliery Explosions.
35. The Use of Electrical Energy in working Mines.
36. The Drainage of Mines by Pumping and by Tunnelling.
37. The Extraction of Metals from their Ores by electrolytic processes.
44. The most suitable Steam-power Equipments for Electric light stations.
45. The Utilisation of Electric Lighting Plant during hours of small demand.
46. The Utilisation of Electrical Energy in the form of heat.
47. The Regulation of Electric pressure in large lighting circuits as carried out at the engine, the dynamo, or the exciter.
48. The Theory and Practice of the Transmission of Power by Alternating Currents.
49. The Use of Electrical Motors for driving machines in textile factories and in engineering workshops.
50. The first cost, facility and economy of operation of Electrical Traction on Railways with heavy trains and on Tramways.
51. The Municipal Control of Tramways with a view to their working electrically, in conjunction with electric lighting.
52. The Construction and Working of Electrical Lifts and Cranes.
53. The Electrolytic Action of Return Currents in Electrical Tramways on gas and water mains, and the best means of providing against Electrical Disturbances.
65. The Use of Electrical Machinery for lighting and the transmission of power in warships and in the mercantile marine.
67. The Progress of Telegraphy and Telephony at home and abroad.

The following awards have been made:—

A Telford Medal and a Telford Premium to Matthew Henry Phineas Riall Sankey, late Captain R.E., M.Inst.C.E., for his paper on "The Thermal Efficiency of Steam Engines."

A Telford Medal and a Telford Premium to James Alfred Ewing, F.R.S., M.Inst.C.E., for his paper on "The Magnetic Testing of Iron and Steel."

A Telford Medal and a Telford Premium to John Oliver Arnold, for his paper entitled "The Influence of Carbon on Iron."

A Crampton Prize to Thomas Wrightson, M.Inst.C.E., for his paper on "The Dilatation, Annealing and Welding of Iron and Steel."

A Crampton Prize to Horace Field Parshall, Assoc.M.Inst.C.E., for his paper on "Magnetic Data of Iron and Steel."

For Papers Printed in the Proceedings (Part IV. of Session 1894-95) without being Discussed.

A Manby Premium to Alan Brebner,* B.Sc., Assoc.M.Inst.C.E., for his paper entitled "The Powers of Lighthouse Lights by Calculation."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

22,571. "Incandescent electric light decorations." A. A. Pollock. Dated October 12th.

22,584. "Improvements in wall sockets for electric lighting and like fittings." G. Byng. Dated October 12th.

22,585. "Improvements in fittings for electric light and like purposes." G. Byng. Dated October 12th.

22,595. "Improvements in electric accumulators." A. George. Dated October 12th.

22,599. "Improvements in dynamo electric machines." V. A. Fynn. Dated October 12th.

22,600. "Improved method of and means for electrically connecting railway rails." G. H. Scott. Dated October 12th.

22,633. "A high speed dynamo." H. C. Madsen. Dated October 12th. (*Complete.*)

22,661. "Improvements in electrical bell pushes or their equivalents." R. Bell and W. T. Hall. Dated October 13th.

22,691. "Improved high insulation cord grip ceiling rose." F. W. Heaton and H. Smith. Dated October 13th.

22,703. "Improvements relating to the generation of gas and electricity and to apparatus therefor and the application thereof to motive power purposes." S. H. Short. Dated October 13th. (*Complete.*)

22,704. "Improvements in electric brakes." H. H. Lake. (E. A. Sperry, United States.) Dated October 13th. (*Complete.*)

22,744. "Improvements in or relating to switches for electric batteries." W. Turner. Dated October 13th.

22,746. "Improvements in or connected with automatic switches for controlling electric lamps." W. J. Davy. Dated October 13th.

22,783. "Improvements in electric locking and block apparatus on railways." F. T. Hollins. Dated October 14th.

22,796. "Improvements in and relating to electrical indicators." M. W. Stikeman and R. P. Wilson. Dated October 14th.

22,820. "Improved method of constructing, mounting, and arranging the underframe and driving appliances of electric and other motor-cars, and in means or apparatus for reducing vibrations and oscillations and to facilitate ease of action in starting such cars." H. Carmont. Dated October 14th.

22,833. "Improved means or appliances connected with electric arc lamps." J. H. Rose. Dated October 14th.

22,844. "Improvements in electric arc lamps for projection." E. Klupathy. Dated October 15th.

22,886. "Improvements in electric railways." N. H. Balfour and E. W. Smith. Dated October 15th.

22,893. "High voltage electric incandescent lamp." F. J. Satchwell. Dated October 15th.

22,926. "Improvements in electrical devices and in insulating supports for same." R. W. James. (W. White and J. H. Davies, South African Republic.) Dated October 15th.

22,947. "An improved electrical joint." A. F. B. Gomess. Dated October 15th.

22,967. "An improved method of connecting electric wires." W. H. Dorman. Dated October 16th.

22,979. "Improvements in machines for covering electric or other wires or cables." W. A. Phillips. Dated October 16th.

22,980. "A new or improved method and means for fire-proofing insulated wires and cables." W. A. Phillips. Dated October 16th.

22,990. "Improvements in appliances for the intercommunication of telephones." J. D. F. Andrews. Dated October 16th.

23,040. "Improvements in the construction of electrical accumulators and primary cells." A. G. Adamson. Dated October 17th.

23,071. "Improvements in switches for electric currents." J. J. Rawlings and W. R. Rawlings. Dated October 17th. (*Complete.*)

23,084. "An improved cell for controlling the direction of flow of electric currents, or retarding such flow and for like purposes." W. P. Thompson. (L. Gratz, Germany.) Dated October 17th.

23,098. "Improvements in writing telegraphs." W. S. Stelis. Dated October 17th.

* Has previously received a Telford Medal and Premium.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1895.

19,989. "An electric tell tale or watchman's recorder." J. W. Fletcher. Dated October 24th, 1895. Relates to an arrangement of electro-magnets, resistances and registering clock so combined that a record is kept showing that a watchman or other person has visited in the proper order each station, position, or locality, he has been appointed to inspect. The apparatus can be arranged for any number of stations the first station consisting of an electro-magnet having its armature connected to one terminal of the line so that when operated by the key it completes the circuit through the electro-magnet and therefore remains in that position until the circuit is broken by other means. The remaining stations, with the exception of the last are similar to the first except that when the armature is not attracted the circuit including the first and the previous stations is completed through a resistance. At the last station is merely a circuit breaker operated by the key, the registering clock being arranged to make the record when the circuit is broken. 4 claims.

21,137. "Electrical tramway and railway conductors." G. H. Nisbett. Dated November 8th, 1895. Relates to flexible metallic conductors for use in connection with tramway and railway work, and consists of a single conductor of circular form, having a smooth exterior, and made up of a plurality of members or stands of metal of the form of a section of a circle, so that a given number of them, when arranged side by side, form a complete cylinder, these members or stands being twisted and arranged with a "pitch," so that they will hold together when made up into a conductor. 1 claim.

22,207. "Improvements in electrodes suitable for electrolytic apparatus." C. Kellner. Dated November 21st, 1895. Relates to electrodes for use in electrolysis on a large commercial scale, and consists of a tube made of thin platinum, preferably provided with lateral rib-like projections, and carried by a metallic body, which is inserted or cast in the platinum tube, so as to lie close up against it on all sides, and serves for supplying or conducting the electric current. 2 claims.

1896.

14,500. "An improved call counter suitable for telephone exchanges." F. Stock. Dated June 30th, 1896. Relates to call counters operated by mechanical effect, the want of certainty as with electro-magnetic counters is avoided, and the construction simpler. This invention is characterised essentially by a train of wheels which is operated on putting the plug into the spring jack by means of a dog and a ratchet wheel, and which is kept in such small dimensions that one of them can be arranged on each subscriber's spring jack. 4 claims.

14,846. "Improvements in conducting contacts with carbon or other non-metallic electrodes." Siemens Brothers & Co., Limited, and E. F. A. Obach. Dated July 4th, 1896 Relates to the construction of durable conducting contacts with carbon or other non-metallic electrodes which consists of a saddle of lead cast on the electrode, and a hole drilled through the sides of the saddle and electrode into which is placed a lining of thin sheet platinum, a plug of metal which expands in setting, is then cast into the hole, so that the platinum becomes closely pressed against the plug and the electrode. A multiple contact is formed by inserting studs projected from a metallic bar into the holes lined with platinum and plugged with an alloy which expands in setting. 2 claims.

16,421. "Regulator for dynamo machines." A. Hensch and P. Brandt. Dated July 24th, 1896. Relates to a regulator for dynamo machines constructed in such a manner that on the occurrence of variations in the potential in the main circuit, a rotary contact arm is moved by means of a differential coil, whereby current is sent into a motor in one or the other direction, thus moving a switch arm so as to increase the resistance in the field magnet circuit or cut it out therefrom according to requirements. 1 claim.

16,457. "Improvements in solenoid cores for voltmeters." P. Brandt and A. Hensch. Dated July 24th, 1896. Relates to solenoid cores for voltmeters, which consist of a soft iron case which encloses a bundle of wire, the reciprocal inductive action between said case and bundle neutralising or rendering harmless the residual magnetism. Should the electric tension diminish the residual magnetism of the bundle, same will act upon the case in such a manner as to suppress the residual magnetism of said case, the forces in the case and bundle thus neutralising one another and minimising the danger of inaccuracies. 1 claim.